JANUARY 2, 1956 50 CENTS

AVIATION WEEK

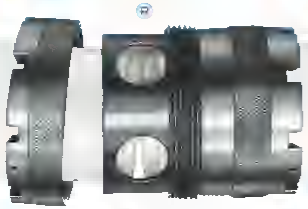
A McGRAW-HILL PUBLICATION

Inertial Guidance: Out of Laboratory Into Missiles—Part I

•

Latest F11F Design

WIG-O-FLEX COUPLING



flexible union for connecting rigid tubes

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The New Douglas B-66B Bomber is 17 pounds lighter because WIG-O-FLEX Couplings replaced standard AN Connections and cut hose. The WIG-O-FLEX Coupling weighs 1/5 as much as the standard AN connection it can replace. (See weight chart for exact comparisons.)

PROVEN SUPERIOR FOR FUEL, OIL, AIR

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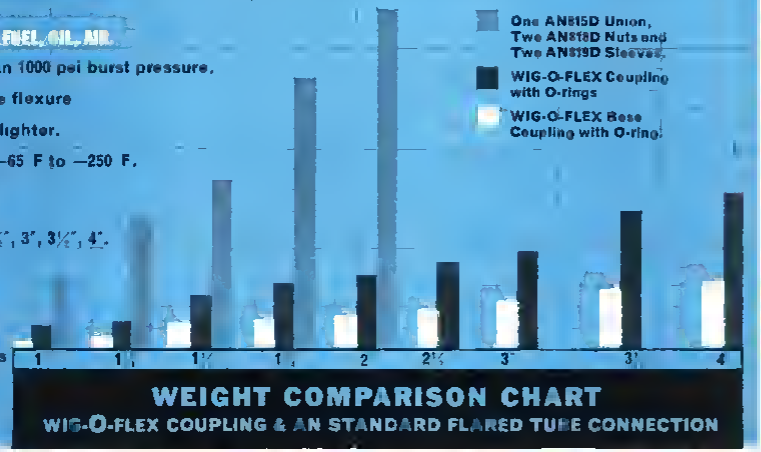
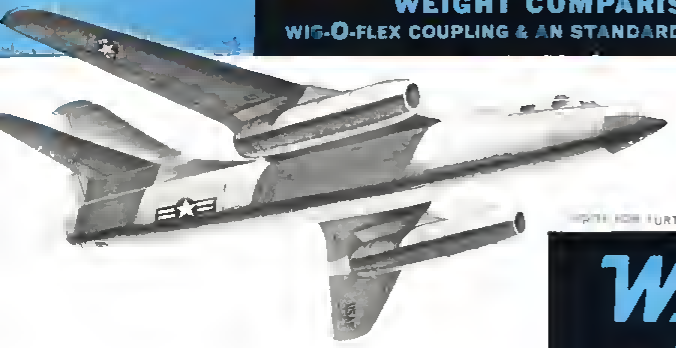


WEIGHT COMPARISON CHART
WIG-O-FLEX COUPLING & AN STANDARD FLARED TUBE CONNECTION



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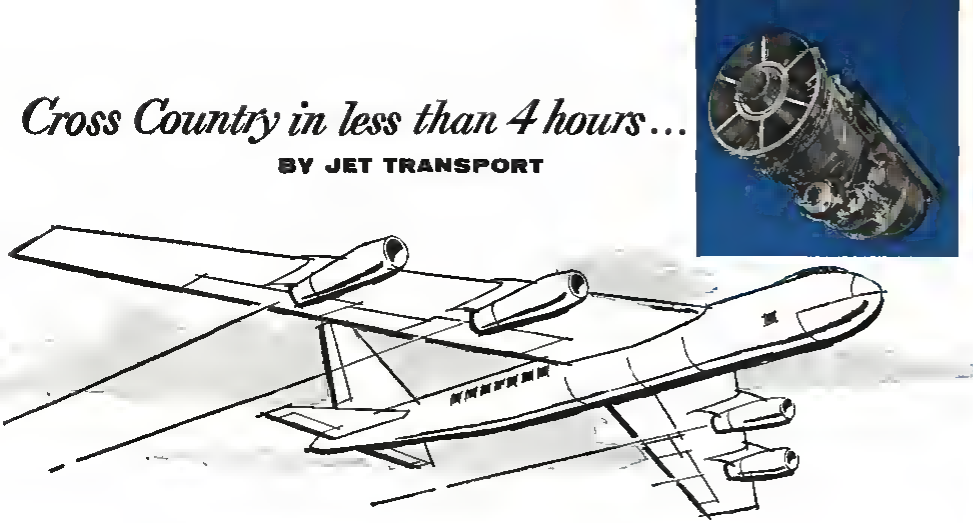

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This important assignment typifies the way prime contractors rely on Twin Coach Aircraft Division. For Twin is staffed with experienced aircraft specialists to design and build tooling . . . with experienced aircraft production personnel . . . under experienced aircraft supervision and management.

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AA-1431

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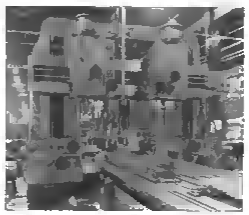
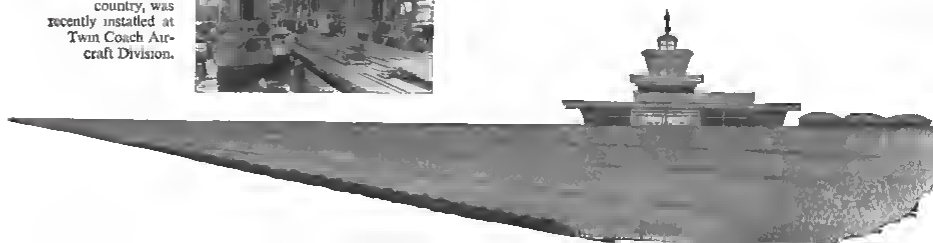


Giant 25-foot Droop & Rein universal planer mill, only one of its kind in the country, was recently installed at Twin Coach Aircraft Division.



MISSILE SYSTEMS

AERODYNAMICS

The rapid growth of missile systems technology has placed new demands on the ability of aerodynamics scientists. At Lockheed Missile Systems Division, new advances are required constantly in thermodynamic analysis, aerodynamic design analysis, flutter, aero-elastics and flight dynamics.

Continuing experimentation at Jet Propulsion Laboratory, Ames Aeronautical Laboratory, Gas Dynamics Facility at Princeton University, Naval Supersonic Research Laboratory at Massachusetts Institute of Technology, Langley Memorial Laboratory and other centers supports this program of expanding aerodynamic activities.

These advances have created new positions for aerodynamics scientists possessing advanced academic training in the following areas:

■ **Design Aerodynamics Engineer** to perform theoretical analyses and evaluate experimental data on high-speed flow phenomena as related to performance and stability characteristics of missiles or supersonic aircraft. The position requires at least five years' related experience.

■ **Experimental Aerodynamics Engineer** to plan, supervise, analyze and report on experimental programs. The position requires a sound background in supersonic aerodynamics and at least five years' experience, preferably in wind tunnel testing or full-scale and free flight model testing.

■ **Experimental Aerodynamicist** to assist in planning and reporting on experimental programs. The position requires one to two years' experience in wind tunnel testing or full-scale and free flight model testing.

Those who wish to advance their professional stature, while contributing to a group effort of utmost importance, are invited to write.

Lockheed **MISSILE SYSTEMS DIVISION**

research and engineering staff

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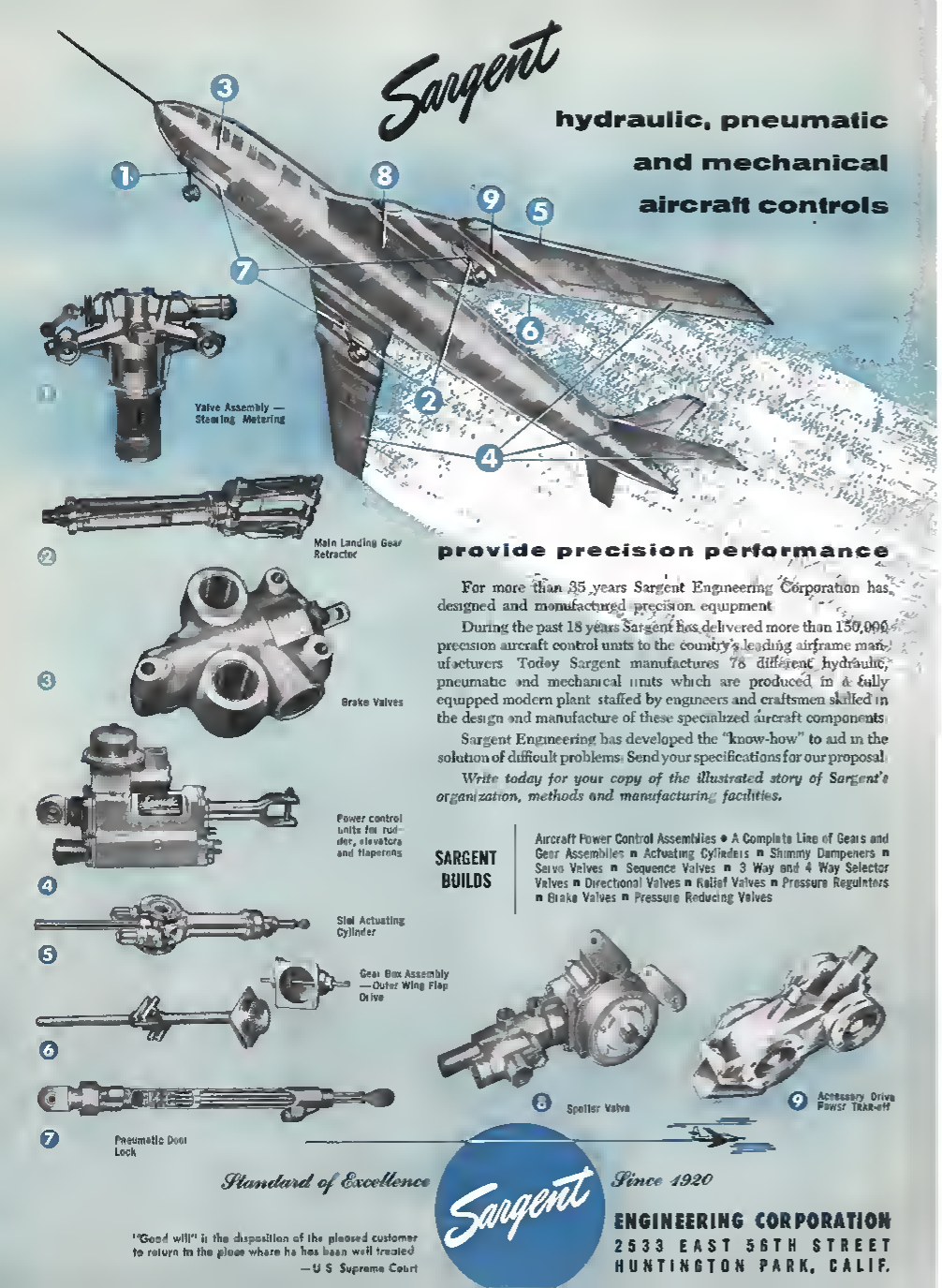

JANUARY 2, 1956

AVIATION WEEK

VOL 64, NO 1

Editorial Offices

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59,121 copies of this issue printed

AVIATION WEEK • JANUARY 2, 1956 • Vol 64, No 1
Member ABP and ABC

Published weekly with an additional issue in December by the McGraw Hill Publishing Company James H McGraw (1860-1948) Founder Executive Editorial Advertising and Subscription Offices McGraw Hill Building 330 West 42nd Street New York 36 N Y Publication Office 99-129 North Broadway Albany 1 N Y Donald C McGraw President Paul Montgomery Executive Vice President Joseph A Gerardi Vice President and Treasurer John J Cooke Secretary Nelson Bond Executive Vice President Publishing Division Ralph B Smith Vice President and Editorial Director Joseph H Allen Vice President and Director of Advertising J E Blackburn Jr Vice President and Circulation Director

Subscription Address correspondence to AVIATION WEEK—Subscription Service, 99-129 North Broadway Albany 1 N Y or 330 West 42nd St New York 36 N Y Allow 15 days for change of address

Subscriptions are solicited only from persons who have a commercial or professional interest in aviation Position and company connection must be indicated on subscription orders.

Single copies 60¢ Subscription rates United States and possessions $6 a year $9 for two years $12 for three years Canada $8 a year $12 for two years $17 for three years payable in Canadian currency or par Other Western Hemisphere and the Philippines $10 a year $17 for two years $23 for three years All other countries $20 a year $29 for two years $40 for three years Second class mail privileges authorized at Albany 1 N Y Printed in U S A

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EDITORIAL

The Critical Race in Research

We are now entering the most critical phase in the military research and development race we have been running for the past decade against the Communist powers. Our monopoly on atomic fusion and fission weapons is gone and our monopoly on effective aerial delivery systems is ending.

In this period of atomic deadlock, when both we and the Communist powers will have the capability of delivering a devastating atomic attack, the need for dynamic drive through scientific frontiers to develop new and unmistakably superior weapons will become paramount both for enforcing peace in a troubled world and avoiding defeat in an atomic global war. Our survival in both peace and war will depend largely on the speed and skill with which we run this research and development race against our international competitors.

Delay Is Fatal

In formulating and pushing a wise and effective research and development policy for this critical period we are already late. Any further delay will prove fatal. Many of the scientific and military men most familiar with the tasks ahead are driving hard in the right direction. But there are too many disturbing signs that top level policymakers in the Pentagon, White House and Congress do not fully understand the problem. They appear to be approaching it shackled with obsolete concepts that will make any effective action impossible.

The most dangerous of these concepts is that of the "constant level research and development budget." This is the current policy of the Pentagon and the executive branch of the Government and has found some favor in Congress. This policy is aimed at keeping military research and development expenditures at the same level—about $1.2 billion total, of which $400 million is for the Air Force—for the foreseeable future. Actually, budget figures for USAF research and development now bring its total to more than $500 million, but this is a bookkeeping change and does not represent any real increase in the program over previous years.

This "constant level" concept is bandied about the Pentagon with a smugness that implies it will insure our technical superiority in the weapons development race.

Nothing could be further from the truth.

Technical Growth Rate

For technical progress—as are most kinds of natural progress made by man—is a geometrical progression. Plotting the natural growth curve of such key indices as the gross national product, population and electrical energy available for industrial use during the last 50 years will show clearly that they follow the same geometric progression as aeronautical progress.

To follow the natural growth potential of this progression, we must achieve more technical progress during the next five years than we have since the beginning of powered flight. This will be possible only if we have available an expanding research and development budget that follows this same natural growth curve instead of the fruitless zig zags of aviation research funds during the past three decades.

The technical revolution that hit aviation with the advent of the gas turbine powerplant and nuclear weapons is spawning new problems faster than our present research pace can solve them. Without speedier progress, we will actually lose ground by falling behind the pace established by natural growth. Each new scientific achievement in aeronautical research creates a new family of problems that require solution. Transistors in avionics, the gas turbine in propulsion, atomic fission and fusion in aerial weapons, are all typical of basic new scientific achievements that have expanded and intensified our research and development problems.

To maintain a constant level of research expenditures at an artificial, politically-dictated rate in the face of our expanding scientific problems is the sheerest folly. If it becomes an accepted national policy, it will force our scientist-engineer team to run artificially handicapped, as in a three-legged race, against their international competitors. There is no doubt that the Russians clearly recognize the real nature of the problem and are putting manpower, brains and money into their weapons development at an ever increasing rate.

Decision Now

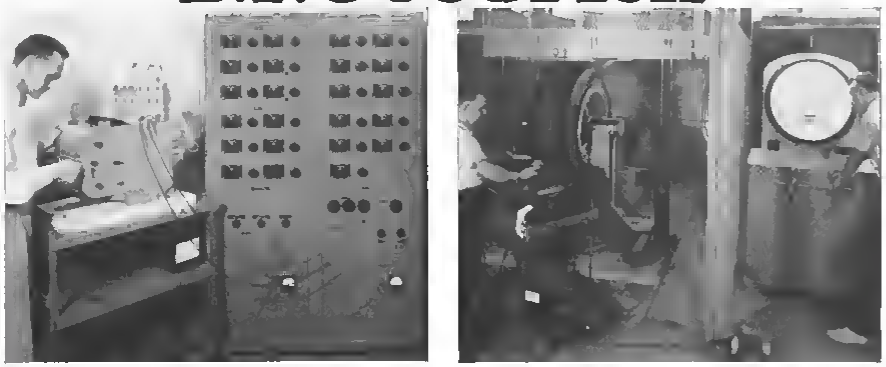
This is a decision we must face immediately. We have a long history of frantically boosting aeronautical research and development funds in a vain effort to meet a crisis that is already upon us. As late as 1952 we were appropriating bigger research and development budgets in a futile hope of meeting the problem of the Korean war where the shooting had already begun.

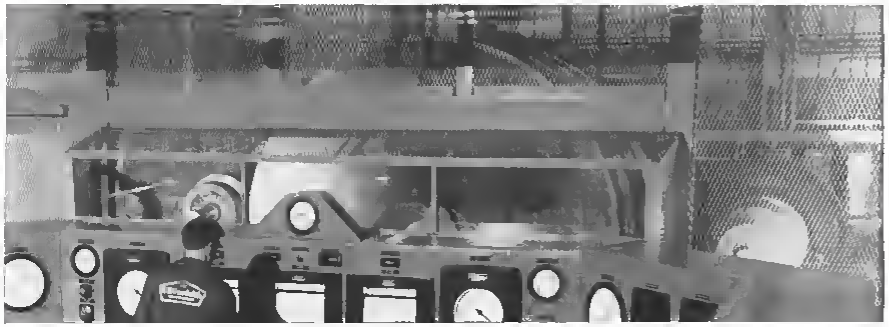
The research and development investments we make today will irrevocably determine the kind of a country we will have tomorrow or whether we will have it at all.

If we fail to maintain a superior pace of scientific development with an adequately expanding research and development budget, we will not only jeopardize the billions to be spent on future aerial weapons systems, but we will also fatally undermine the future of this country as a free nation.

—Robert Hotz

RESEARCH KEEPS **B.F.Goodrich** FIRST IN RUBBER





How to land a bomber in a phone booth

BEFORE B F Goodrich engineers devised and built the computer in the upper left hand picture, testing a new brake design was a time consuming process Laboratory tests of the finished product—sometimes even actual flight tests—had to be made before basic design specifications could be confirmed or modified But now BFG design engineers have a short-cut An electronic analog, almost small enough to fit in a telephone booth, simulates a landing and gives preliminary data—in minutes! BFG engineers correct and refine brake design data in the earliest stages, avoid blind alley tests that could waste weeks or months

How do you benefit? We give you faster delivery by speeding up qualification of our brakes We give you better braking assemblies because we can quickly confirm new engineering and design ideas And you further benefit by actual dynamometer tests which verify the analog's electronic fortune telling.

At top right you see a BFG forged magnesium wheel passing a terrific static overload test Strains applied by the 500,000 lb loading machines are being measured by resistance strain gages and recorded on the oscillograph

Even more dynamic is the "refused take off" test on the 250 mph dynamometer A bomber's *single* wheel and dual brake combination must absorb more than 30,000,000 ft.-lbs. of kinetic energy —as much force as is generated by stopping approximately 65 automobiles going 60 mph—but the BFG brakes bring the plane to a standstill in the specified landing time which assures a safe stopping distance The wheel is undamaged

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WHO'S WHERE

In the Front Office

Rear Adm G Debaun, (USN, ret), executive assistant to vice president of Aircraft Radio Corp Boonton, N J, formerly officer in charge of aircraft communications in Office of Chief of Naval Operations

John J. Giba, vice president Contracts Division, American Bosch Arma Corp, Roosevelt Field, Garden City, N Y He was formerly assistant chief engineer

Robert L Morgan, vice president engineering Neely Enterprises, Hollywood Calif, electronics firm Succeeding him as sales manager is **Robert H Brunner**

Capt T H Templeton, (USN, ret) executive assistant to president of Reed & Reese, Inc, Pasadena Calif, electronics firm, formerly director and commanding of fleet Office of Naval Research branch office in Pasadena

Dr John T. Burwell, Jr., vice president Horizons, Inc, Cleveland, Ohio, industrial and government research firm

Honors and Elections

Dr Edward R Sharp, president for 1956 of the Institute of the Aeronautical Sciences Dr Sharp, director Lewis Flight Propulsion Laboratory, National Advisory Committee for Aeronautics, will be installed Jan 23 at the Honors Night Dinner in New York

T G Lanphier, Jr., vice president assistant to the president Convair Division General Dynamics Corp, re-elected president of National Aeronautics Assn Miss **Jacqueline Cochran,** re-elected first vice president and Mrs M T (Arlene) Davis was re elected treasurer Re elected vice presidents of the association Willis C Brown Jon D Carsey, Jack Hughes, Mrs Frances W Nolde Vernon Pick Jennings Randolph, John F Victory and Denver M Wright New vice presidents Maj Gen Lucas V Beau, USAF commanding, Civil Air Patrol, Dr Leslie A Bryan, director University of Illinois Institute of Aviation, Mrs Harry K Coffey George Haddaway, James D Ramsey and William C Ong Louis E, Leveroue, past president, was elected to the board to fill a vacancy Named to the executive committee for 1956 William F MacCracken, chairman T G Lanphier (ex officio) Donald W Douglas, Jr Richard S Boutelle, William R Enyart, Roger W Kahn and A Paul Vance

Changes

Dr Sherrerd B Welles, manager Missile Systems Laboratory, Sylvania Electric Products, Inc, Waltham Mass, succeeding Dr Edwin G Schneider, chief engineer, electronic Systems Division

William Henderson, Jr., manager government sales Federal Telephone & Radio Co division of International Telephone & Telegraph Corp

Otto A Dworak, manager, Convair Ft Worth resident office in San Diego, Calif to coordinate interdivision commitments on the Convair F-102A Stanley Hillman succeeds him as chief of outside production

(Continued on page 55)

INDUSTRY OBSERVER

►Northrop Aircraft may be getting sizeable production contract for Snark with rate possibly as high as 50 to 60 missiles per month.

►Proposals for all-weather interceptor versions of the Lockheed F-104 and North American F-107 supersonic fighters have been submitted to the Pentagon as possible back-up aircraft for the Convair F-102 in the Air Defense Command equipment inventory.

►Convair's F-102B equipped with a Pratt & Whitney J75 turbojet is scheduled to make its first flight by next fall.

►General Electric's Special Defense Projects Department, now working on an important long-range missile contract, will move from Schenectady, N Y, to a Philadelphia suburb The Special Defense Projects Department, formed six months ago, drew upon General Electric's Hermes missile project for technical personnel

►Air Force is interested in development of chaff-carrying rockets that would be fired ahead of its aircraft to confuse enemy radar.

►Republic Aviation has hired a group of scientists who recently resigned from Lockheed's Guided Missile Division after a sharp policy disagreement (AW Dec 19, p 16) They will work in Republic's Advanced Development Division rather than the Guided Missile Division.

►Rand Development Corp. has developed a technique for plating titanium with nickel or chromium for Cleveland Pneumatic Tool Co Plating is necessary because titanium parts gall easily under friction and may fail The Rand process has been turned over to Cleveland Pneumatic for further study.

►Military electronic equipment and component deliveries during 1955 amounted to about $2 4 billion an increase of $100 million over 1954.

►Radar equipment, built in the U. S. to Russian standards on specifications furnished by USAF, is being evaluated against comparable U. S. radars by at least one electronics manufacturer.

►USAF still is expanding its airlift of engines from home depots to overseas bases More than 500 engines a month are being shipped by air to the Pacific, Europe and Alaska.

►Air Materiel Command's depot maintenance contracted to private industry increased from 39 to 48% of total value in 1955. Industry now collects approximately $254 million annually for this work on aircraft and various components.

►Remote transmission of data from military air defense radars to civil air route traffic control centers in the Boston-Norfolk area could be accomplished with an initial installation cost of approximately $245,000, and an annual operating cost including amortization of approximately $132,000 according to a recently completed study by Radio Technical Commission for Aeronautics The commission committee recommended use of "narrow band" remoting techniques, such as the system developed by Haller, Raymond & Brown Inc.

►U. S. Army will move six field artillery battalions equipped with the Corporal guided missile to Europe in the first four months of 1956. They now are based at Ft Bliss, Tex.

►A faulty pin in the compressor section of the General Electric J73 engine has caused the Air Force to ground the F-86H Sabre. Less than a hundred J73 engines have the faulty pin and most of these are spares Only minor modification is required to fix the compressor, USAF said

TITANIUM helps lift the C-130 higher and faster . . . with heavier payloads

Titanium is an *essential* material for high-performance aircraft. On the new Lockheed designed Air Force C-130 turbo-prop medium combat transport, titanium's high strength-weight ratio . . . exceptional resistance to corrosion . . . and freedom from stress corrosion cracking, play a vital role.

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Washington Roundup

More CAA, CAB Fees?

Question of additional fees for Civil Aeronautics Administration and Civil Aeronautics Board services to industry will come up in the new Congress—but nothing is likely to be done about it. The staff of the Senate Government Operations Committee has prepared a factual report on the fee policies of all government agencies. But this committee takes the position that it is up to the committee with specific jurisdiction—the Commerce Committee for Commercial Aviation—to take action. Commerce Committee last year tossed the issue to the Government Operations Committee.

CAB Condidotes

T. B. Wilson, former chairman of the board of Trans World Airlines and now Deputy Under Secretary of Commerce, is understood to be the choice of Louis Rothschild, Under Secretary of Commerce for Transportation, to replace Ross Rizley as chairman of the Civil Aeronautics Board. It is generally accepted that Rizley will leave the Board this month for a federal judgeship. Sen. Warren Magnuson (D.-Wash.), chairman of the Senate Commerce Committee which will consider the new appointee, is understood to look favorably on the appointment of Wilson, who served as vice president of Alaska Steamship Co. from 1933 to 1938.

Sen. Mike Monroney (D.-Okla.), chairman of the Commerce Aviation Subcommittee, is reportedly supporting the appointment of Richard Lloyd Jones, publisher of the Tulsa Tribune, to Rizley's place.

Smoll Business Goins

Watch for telling arguments from USAF to prove small business has nothing to complain about, when Congress starts its annual probing into how contracts are let and who gets them. In first four months of Fiscal 1956 total procurement from industry was down to $862 million from $1.4 billion in same period of 1955. Yet the contract awards to small business jumped from $117 million to $142.4 million. For Fiscal 1955, small business was awarded $577 million in contracts, up $20 million from 1954.

Higher CAB Solories

On the agenda for prompt Senate action is legislation raising the salaries of Civil Aeronautics Board members from $15,000 to $20,000 a year, and the CAB chairman to $20,500. The Secretary of Commerce would be raised from $22,500 to $25,000 a year, and the Under Secretary for Transportation from $17,500 to $21,000.

The salaries of the secretaries of the Air Force, Navy and Army would be increased from the present $18,000 to $22,000.

CAA Telecommunicotions Tronsfer

Civil Aeronautics Administrator Charles Lowen hasn't made a decision on the proposal to turn over CAA's telecommunications system to private interests.

Rep. Robert Mollohan (D.-W. Va.) claimed that it was not "unreasonable to conclude" that the firing of Fred B. Lee as CAA Administrator was dictated by Lee's refusal to approve the transfer of the communications net (AW Dec. 26, 1955, p. 11).

The initial proposal for transferring the communications system to private industry was among the recommendations made by the management firm of Cresap, McCormick and Paget in its survey of CAA operations. The report, which cost $104,000, was ordered by former Under Secretary of Commerce Robert Murray. The report has never been publicly released and has been a source of controversy in the CAA.

Policy of the Administration generally has been to turn over as many Government operations as possible to private industry to eliminate duplication. Lee claimed the transfer would be illegal.

Nonsked Fight

The scheduled airlines will take their case against Civil Aeronautics Board's decision opening the air transportation field to wider participation by non-scheduled airlines to Congress.

Their position will be that the Board decision is "in disregard of the mandate of the 1938 Civil Aeronautics Act."

The controversy centers around the authority granted the new Supplemental Air Carriers to operate ten scheduled flights a month between any two points. The scheduled airlines raised strong objections with CAB on the decision and the fight will go on in the courts as well as Capitol Hill.

Army Information Chonge

Veteran Army public information workers are disturbed by new staff setup which places their activity under the Deputy Chief of Staff for Personnel. While they anticipate no immediate trouble because incumbents know information workers must deal with all Army offices, they eventually may be handicapped. Top personnel post could be filled in future by an officer with no aptitude in press relations. He could hinder PIO workers in their contact with other Army branches, effectively cut off sources in Personnel itself, an important source of Army news. Arrival this week of Maj. Gen. Guy S. Melo, Jr., to replace Brig. Gen. Theodore S. Riggs as Army Chief of Information may soon set off new effort to have his office responsible directly to the Chief of Staff.

Indion Biloterol

The U.S.-Indian bilateral agreement dispute may be settled soon. A U.S. delegation returning to complete negotiations is expected in New Delhi early this week. After extensive consultations held in India last fall, the U.S. delegation brought Indian proposals back to Washington for study and has now returned to renew discussions.

Indian sources expect an agreement to be signed which represents a compromise between the American principle of letting economic factors dictate schedule frequencies and the Indian desire to increase its share of the travel market by controlling frequencies. Settlement of differences with a compromise between these viewpoints would end a long period of futile negotiation between the two governments.

—Washington Staff

USAF Aligns Industry for Atomic War

Industrial production readiness policy outlines concepts to compress, accelerate weapons output

By Claude Witze

Washington—The Air Force gave the U.S. aircraft industry a formula last week to achieve immediate production readiness in case of atomic war.

USAF Secretary Donald A. Quarles said, in effect, that the threat of attack by Soviet long range strategic bombers has outmoded previous concepts of industrial mobilization. USAF's top-priority weapon systems must be "ready," not "mobilized."

In case of war, every available piece of hardware must be thrown into the breach at once with special emphasis on weapons needed by the Strategic Air Command and Air Defense Command.

USAF spokesmen said their new Industrial Production Readiness Policy has been approved by the Department of Defense and that it is complementary to all war plans approved by the Joint Chiefs of Staff and the National Security Council. They said it does not conflict with any of the plans and is designed to carry them out.

Essential to Air Force

There was no open indication of why the Army and Navy have not taken similar steps or why the new readiness policy was not promulgated by the Defense Department for all branches of the service. Some Pentagon observers concluded that preparations for a 30-to-90 day war are necessary under present plans adopted over protests of the Army and Navy.

USAF, on the other hand, pointed out that the new readiness policy is most essential for its mission, largely because SAC and ADC will be the first in action in case of a general war. Far from neglecting the industrial needs in case of a Korea-type war, USAF said, the new plan will speed mobilization in this case as well. This includes the Army's need for aircraft purchased through USAF channels.

Twin Capabilities

However, USAF emphasized, the new approach is essential "because, for the first time in modern history, our nation is faced with a continuing potential threat of devastating destruction at the outset of general war. If, in an emergency, we are to survive and minimize the devastation to our nation, the traditional concept of a prolonged industrial buildup after attack must be replaced with a readiness program."

For the aircraft industry, the new policy calls for perfection of two new "capabilities."

The first is Production Compression Capability (PCC). This will insure maximum all-out production of strategic and air defense weapons in the first 60 to 90 days of a general war. The program must go into effect instantly in case of an emergency.

"This immediate increased production can be achieved," Secretary Quarles said, "with workable plans for a maximum work week and draining the normal inventory of finished components, equipment and sub-assemblies on hand in the assembly plant." He added that potential output can be increased by having a bigger inventory of finished items on hand and that this will be done in plants where it is justified on the basis of production, cost and criticality of the weapon system.

Here are the assumed wartime conditions in a plant ordered to set up a PCC program:

- The assembly plant will remain intact.
- No additional personnel will be available during the all-out production period.
- There will be no support from Government furnished aircraft equipment (GFAE) producers, subcontractors or vendors during the period.
- Loss of all except local transportation facilities.
- Communication facilities limited to high priority messages.

Second type of major wartime effort provided for in the new readiness policy is Production Acceleration Capability (PAC). It will provide for faster production of tactical or supporting systems to a predetermined peak rate in the shortest possible time.

This can be accomplished, Quarles said, "by maintaining readily expansible production capacity and increasing the inventory of finished and semi-fabricated materials at prime, associated and subcontractor facilities. This capability must be created in advance of an emergency so that it can go into effect immediately."

- The increased inventory of materials will be purchased with directed funds. It will be consumed as the last increment of aircraft is produced under the current program.
- Production acceleration will be applied on a very selective basis dependent upon production status, duration of increased production capability, additional costs and criticality of the weapon system or supporting system mission.
- Production acceleration plans will be of greatest value in limited wars or peacetime expansion.

Category Plan

The new USAF policy emphasizes that resources, which means money as well as production facilities, are limited. For this reason, the program will not be applied overall to the aircraft industry, but on the basis of selective planning.

Major aircraft and missiles will be divided into categories, assigning each to a priority rating (see box, p. 18). The weapons so classified will be those on the secret Minimum Wartime Aircraft and Guided Missiles Requirements List forming a new Selective Planning List, issued in May and November of each year.

USAF spokesmen said prime contractors will be responsible for participation of their subcontractors in the program. In order to help in this effort, USAF will maintain close ties with the industry to make sure all plans are realistic and feasible.

While it is not anticipated that there will be changes in existing contracts, selected systems in Categories A and B will have contractual provisions in future procurement.

For top-priority items in Categories A and B, specific steps to achieve readiness will include establishment of at least two sources for both weapon and support systems, at least one of them distant from prime targets.

Other procedures for Category A:

- Weapons for SAC and ADC will be built on a 2-shift, 5 day, 40-hour week basis. Other basic systems on a 1-shift, 5 day, 40-hour week basis.
- PCC and PAC will be developed for selected systems when warranted by production status, costs and mission requirements.
- Emergency production plans will be developed to facilitate going to emergency schedules as fast as possible with a minimum disruption of effort.
- Plans will be maintained to rapidly reprogram alternate production support in case of an attack that destroys current capacity.

Limit on Finished Stocks

USAF spokesmen emphasized that weapons placed under the PAC program must be beyond the stage where extensive engineering changes are expected. In the case of weapons under PAC, the contractor will be allowed to make advance purchases of raw forgings and similar unfinished parts but there will be limits placed on the stocking of finished parts and assemblies. Raw form purchases may go up 5 to 10%.

In the case of PCC items, it is assumed that subcontractors will be lost and there will be severe industrial damage.

Normal inventory will be maintained with the idea that the manufacturer will be able to get the greatest possible return from what is on hand. He will be expected to utilize test aircraft, expedite delivery of weapons on the line and do anything else possible to get airplanes into operation.

It is not anticipated that the readiness program will add materially to USAF costs. In fact, spokesmen say, one of the major goals is to cut expenses and get maximum mobilization from the available money and machines.

Another major USAF aim is to get away from tools in dead storage, put the most efficient tools in operation to keep the "hot base" in its most useful condition.

Secretary Quarles ordered an immediate review of all current and emergency production of weapons and supporting systems. He said adjustment to the new policy "is to be accomplished as rapidly as possible but with due regard to economic considerations and the various adverse effects of sudden change."

Industrial Readiness

Here is what industrial readiness will do according to USAF:

- **Deter war by maintaining a modern Air Force in being that can immediately defend the nation and retaliate in case of attack.**
- **Make us capable of rapidly expanding production of appropriate weapons in case of involvement in peripheral conflicts or expansions short of a general nuclear war.**
- **Improve industry's ability to maintain or rapidly restore production of critical survival and retaliation weapon systems and related support commodities in case of general war involving severe industrial damage.**
- **Maintain the health of the aircraft industry as necessary to fulfill the needs of the Air Force.**

Aircraft to Receive Priority Ratings

Under its Industrial Production Readiness Policy, Air Force will assign priority ratings to most aircraft and guided missiles. Ratings will be determined on this basis:

- Category A. This category will include the most important Air Force weapon systems and supporting systems which warrant special handling and which must be kept in active production under the most austere emergency conditions. Selection will be based upon recommendations of the Air Staff and Air Council, after the following factors have been considered:
  - How critical is the mission to be performed or supported.
  - Performance capability and versatility of the system.
  - Current production status and general producibility of the system.
  - How vulnerable is the industrial structure required to produce the system.
  - Current inventory quantity of the system.
- Category B. This category will include weapon systems and supporting systems included in the Minimum Wartime Aircraft and Guided Missiles Requirements list which have not been designated Category A. Under extremely austere emergency conditions, surviving production capacity for this category would be reprogrammed to support production of Category A systems as required. Category B systems will be kept in production under adverse conditions.
- Category C. This category includes all remaining weapon systems and supporting systems for which production planning is desirable. Category C systems may not necessarily be kept in production in case of general war involving severe industrial damage. However, capacity for this category could be of great value in rapidly accelerating production during a limited war, emergency acceleration short of general war, and to provide sources that can be reprogrammed to support production of the A and B categories in a general war involving severe industrial damage.

Renegotiation Act and Profits:

Analysis Minimizes Net Worth Factor

Washington—An analysis of the net worth factor in renegotiation emphasizes that taking away as excessive profit everything above a supposed reasonable return on net worth would be a sharp departure from any former practices and a disregard of the intent of Congress.

The analysis was prepared by John T. Koehler, who served as chairman of the Renegotiation Board from 1951 to 1953 and Philip Nichols Jr., general counsel of the board from 1951 to 1954.

Both are now practicing law in Washington.

The aircraft industry in particular has been puzzled by actions of the Board which demonstrate a new and tougher policy on excess profits. The Board has not publicly released information on its facts and reasons in recent redeterminations, causing speculation that net worth may now be given more weight than formerly. Emphasis on net worth would strike hard at the aircraft industry since a substantial part of the facilities used by most aircraft companies is government-furnished. The percentage of profit based on net worth accordingly soars.

Renegotiation Act History

Koehler and Nichols traced the history of the 1951 act which now governs renegotiation actions.

"The 1951 act was first drafted and introduced with a capital and net worth factor reading the same as that in the 1943 act. No doubt it was the influence of the Brewster (former Sen. Owen Brewster) which led the Ways and Means Committee of the House to revise its statement of the factor to read as follows: 'Reasonableness of return on net worth with regard to the amount and source of public and private capital employed.'

"Later on the word 'particular' got to be inserted before the word 'regard' with what effect on the meaning we have never been able to ascertain. However had the language of the House bill become law, there would have been a plain mandate to attempt to determine the reasonableness of return on the contractor's net worth in every case, and to give it more weight than any such determination had been given in World War II.

Investment Incentive

"But the Senate Finance Committee disagreed with the House bill. The committee took out the words 'reasonableness of return on' giving us the factor as we have it today. The committee explains that it believed the House bill was too restrictive since the reasonableness of return on net worth might not in too many cases be an adequate measure of fair profits. The Finance Committee bill was enacted into law; it follows that to say the least there is no present mandate to change prior practice concerning capital and net worth."

Both lawyers noted that consideration

Chessie Takes to Air

Keeping pace with modern executive transportation, the Chesepeake and Ohio Railway has taken delivery of the DC-3 it has leased from Capital Airlines. "C&O's own plane will enable our officers to cover more efficiently over 5,000 miles of railroad operations," said Walter J. Tuohy, the railroad's president. Tuohy (right) is shown at delivery ceremony with Capital's President James H. Carmichael.

must be given to the rate of return on net worth. This is to afford a proper incentive for the investment of equity capital. But the contractor must be allowed enough return on his debt capital, they said, to afford the contractor incentive for running into debt and risking the loss of equity capital.

"There will be cases when the rate of return on net worth will be so high that it will give cause for inquiry, but in many of these cases this return will have to remain at a high level to avoid doing violence to other factors which are of paramount importance," Koehler and Nichols noted.

Both renegotiation experts feel that the board should feel free to disregard the return on net worth altogether in these cases

- When it believes that the book net worth is misleading as to the contractor's actual assets
- When it cannot make a reasonable allocation of net worth between renegotiable business and other business
- When the capital and net worth employed in the business do not afford a measure of the contractor's capacity to contribute to the defense effort.

The Renegotiation Act requires that the board, in determining excessive profits, must give favorable recognition to the efficiency of the contractor and take into consideration these five factors

- Reasonableness of costs and profits.
- Net worth.
- Extent of risk assumed.
- Contribution to the defense effort.
- Character of business.

"Congress has required that net worth be given consideration," Koehler and Nichols said. "It has not required that this consideration be given such emphasis that other and more important statutory factors be subordinated."

NSIA Views

Meanwhile, the National Security Industrial Assn., which serves as a link between the Armed Forces and industry, criticized that returns on net worth are not reliable standards. NSIA said their use tends to stifle incentives for engineering accomplishments, technical resourcefulness, careful cost control, fair and reasonable pricing and general overall efficiency.

NSIA claims the present emphasis on net worth favors inefficient contractors. They cite this example: X company sells a product for $1 and by efficient methods makes $100,000 on a net worth of $200,000. Y company sells the same product for $1.25. Because it is inefficient and ultra conservative in the employment of capital resources, Y company makes only $100,000 on a net worth of $500,000. The efficient X company has a return of 50% on net worth, putting it within the danger zone for renegotiation refunds. Inefficient Y company has a 20% return and is well below the 50% danger point.

NSIA also made these specific criticisms of returns on net worth as a measure of profits

- They do not provide equitable standards for comparison.
- They do not take account of replacement costs.
- They do not measure contributions to the defense efforts.
- They de-emphasize the risk factor.
- They do not treat all capital funds equally.

New Lockheed Facility For Nuclear Research

A large laboratory and two atomic reactors will be the key installations in a new facility Lockheed Aircraft Corp., will build to conduct nuclear research related to atomic-powered aircraft.

The new research center will be located at Marietta, Ga. (AW, Dec. 19, 1955, p. 9) on a heavily wooded site 10 miles square with elevations running from sea level to 2,000 ft.

Informed sources say the laboratory and reactors will be widely separated and be serviced by a narrow gauge railroad which will be controlled remotely. The entire outlay for the new facility will cost between $10 million and $20 million.

Lockheed would make no comment on the subject, but research at the facility presumably will be conducted under a preliminary design study contract on nuclear-powered aircraft with the Air Force. Lockheed first announced the contract in October, 1953.

In addition to studies of radiation patterns of structures and equipment subjected to atomic exposure, scientists at the new facility reportedly will investigate factors relating to pilot and ground crew protection and how waste products of fission will be handled. They also will consider problems inherent to the protection of populace in the event of a plane crash.

Contract for the design of the new facility has been awarded by Lockheed's Georgia Division to Vitro Corp., which is well established in the nuclear and power-generating fields. Work on the plans was started recently. It is estimated that full design of the new facility will take from eight months to a year.

At Lockheed's California Division in Burbank, a staff of physicists and engineers are at work to provide Vitro with standards and technical assistance on problems principally relating to shielding and methods of handling materials. In effect, these technicians are telling the architect what they want in the "house" being built for them.

The physicists and engineers will be transferred to Lockheed's Georgia Division sometime before the completion of the facilities.

Aeroflot Offers Promptness But No Frills

Traveler reports: Soviet pilots are competent, but passengers must fly without safety belts.

Exclusive Report

This article on the service and competence of Russia's state-owned airline was written expressly for Aviation Week by Harry Schwartz, specialist on Soviet affairs for the New York Times, who recently returned from a five-week tour of the Soviet Union. He traveled more than 5,000 air-miles over Aeroflot routes.

By Harry Schwartz

In Moscow one day last fall, a very jittery American correspondent (this writer) got ready for his first ride in a Soviet airplane. As he packed his bags his mind dwelt morbidly on the news item of a few weeks earlier that told of an entire group of Norwegian women killed in a Soviet plane crash. He recalled the stories he had read and heard about Soviet pilots who took off without warming up their engines and who never flew higher than 500 feet above the ground, if that much. The American wondered why he'd ever been so crazy as to get into a business that required him to face the prospect of a 500-mile flight in a plane belonging to Aeroflot, the Soviet airline.

A month—and more than 5,000 air miles in Aeroflot planes—later, this writer met an even more newly arrived American in Moscow. When that neophyte began expressing trepidation about the wisdom of flying Aeroflot this writer was amazed to hear himself saying, "Don't be silly. You'll be just as safe as you'd be on American Airlines or KLM. Aeroflot, that's a real good airline, even if it does omit all the trimmings."

My conversion, if it can be called such, was the product of a simple set of facts. Every one of the half dozen Aeroflot planes I took started its flight on time and landed safely at my destination on time or within five minutes of scheduled arrival time.

Soviet Pilot a Sensible Man

So far as I could judge from my passenger's vantage, the pilots were all sensible men who revved up their engines before taking off, who flew between 6,000 and 10,000 feet above sea level and who planned their flight paths so as to fly over water and through mountain valleys rather than directly over jagged ranges.

In every way, the Soviet flight crews seemed to know what they are doing and to be just as anxious to land safely as I was.

So far as I could judge, simplicity and economy were the keynotes of Aeroflot's planning and service, subordinate only to safety. None of the planes I took had safety belts, less than half had stewardesses, and on none did I get anything to eat or drink. All the planes I took were essentially the same—two engine aircraft carrying a maximum of 21 passengers in seven rows of seats, with an aisle separating the pair of seats on the left facing the engine from the single seat next to the right window. The schedules said two types of planes were being used, Ilyushin 12s and Ilyushin 14s, but to my novice eye all the planes looked identical. Certainly, Aeroflot has no problem of stocking replacement parts for a half dozen or dozen different types of planes of different makes, sizes, speeds, etc. That must save a lot of money.

If a passenger gets airsick, Aeroflot planes carry bottles of mineral water which its stewardesses seem to regard as a specific for airsickness. Anything else the passenger eats or drinks on the plane, he brings himself. Aeroflot feels its obligation to the inner man is satisfied by providing restaurants—good quality ones by Russian standards but sloppy by ours—at its airports and by planning its long-distance hops so there are meal stops for breakfast, lunch and dinner, as appropriate. For passenger entertainment aboard the plane, there are Soviet magazines which the stewardess—if any—distributes. Most of the passengers prefer to go asleep, however, or to watch fascinated as the cabin altimeter records the fluctuations of the plane's vertical position throughout the journey.

For the American or other foreign visitor to the Soviet Union, traveling on Aeroflot is duck soup. Intourist, the Soviet travel bureau, attends to all the details. It buys the tickets and delivers them to the passenger. It provides a private automobile to take the foreigner and his baggage to the airport, as well as a special airport waiting room where he can wait comfortably. When the plane lands, there's an Intourist man and automobile waiting to whisk the foreigner off to his hotel,

PASSENGERS carrying their own luggage disembark from Aeroflot Ilyushin 12 at Moscow's Vnukovo Airport. Vnukovo runways are paved but in smaller cities Aeroflot pilots land on dirt strips. Soviet air travel is a simple matter for foreigners, but it is a different story for the Russians who are faced with the priority system and a lack of ground transport.

baggage and all. It's quite simple.

For the Soviet citizen, it isn't quite that simple. Soviet citizens flying on Aeroflot planes are a motley group of people, varying from engineers and doctors to army privates. Most of them, so far as I could learn from my conversations on planes, were traveling on "komandirovka," that is on business for some government agency or other. But, unless they are important enough to rate their own private car, they seem to have problems getting themselves and their baggage to and from airports. There were no Carev limousines or buses—or anything resembling them—visible at any of the airports where I stopped. Taxis seem to bear some of the load, however. For people traveling privately, Aeroflot normally has at least a small office in the downtown section of each city and people can go there to buy tickets.

'No Show' Soviet Style

Baggage, I should add, isn't normally a problem for the Russian passengers. The limit is 10 kilograms (22 lb.), and I never saw a Russian with anything like that amount or paying an excess baggage fee. Women passengers usually carry big handbags and the men frequently have large briefcases. I'm the foreigner, however, this limit is severe. I had to pay overage on every flight.

Judging by some of the conversation I overheard before some of my planes took off, Aeroflot has the "no show" problem too, without having anything like the elaborate "standby" system available as balancing factor. The "no show" problem must be particularly serious because Aeroflot's passenger capacity is relatively insignificant compared to the size of the country and of its population. At a guess, I would judge that Moscow—the air center of Russia—has less air traffic daily than Cleveland or Detroit. In the summertime, Aeroflot does reach pretty much all over the Soviet Union—or at least all major cities. But after Sept. 30 and until late spring, only main lines operate and even such major cities as Kiev and Odessa, Erevan and Baku are without direct plane connections. The Russian winter, after all, is very severe, and Aeroflot apparently prefers to concentrate its routes on operating a few major routes as safely as possible during the long winter season.

The shortage of plane seats during summer or winter creates a problem of distribution, of course. This is particularly true because Aeroflot's rates are competitive with those of Soviet "soft cars"—the Russian equivalent of Pullmans but not nearly as comfortable—while Aeroflot planes average five or six times the speed of the 30 mile an hour "expresses" which run on Soviet railways. "Locals"—of which Soviet railways have many, even on long distance runs—seem to average 15 miles an hour. Just how they solve the distribution problem I couldn't find out, except that certain groups of people have overriding priorities. One sign I saw at the Minsk Airport listed these three top priority groups of applicants for plane tickets: members of the Communist Party Central Committee, members of the Supreme Soviet (Russia's legislature), and M V D (secret police) field investigation chiefs. There may well be a black market in plane tickets; there is in everything else that's scarce.

Soviet Airports

By American standards, Soviet airports are small and have rather limited facilities for passengers. There's nothing like the maze of shops and services available at Idlewild or LaGuardia for the passenger who takes off from, or arrives at, Moscow's Vnukovo's airport. Vnukovo, at least, has paved runways. Airports at smaller cities don't always have them, but Soviet pilots seem to be quite experienced at landing their planes on ground an American pilot would consider a cowpasture or worse. Curiously, some of those landings I've participated in have seemed smoother than those I've made in some DC-6s landing at big-city American airports.

To sum up: If what you demand from an airline is that it gets you from one place to another relatively fast as compared with competitive means of transport, and with a high safety factor, then Aeroflot would seem to fit the bill. But if you like the comfort of big planes riding at 20,000 feet, pretty stewardesses serving steak dinners and champagne gratis, then keep away. Aeroflot considers those things "bourgeois frills" and it isn't having any, at least not so far.

Military Aviation Funds

The military services had an unobligated balance of $14.1 billion for new contracts for aircraft, engines, parts and guided missiles on Nov. 1.

During the first four months of Fiscal 1956—July through October—cancellations exceeded new military aircraft contracts by more than $104 million. This was primarily due to USAF's showing of $284 million net in cancellations. It was offset by Navy contracts of $250 million over cancellations during the period.

	OBLIGATIONS (000 Omitted)		EXPENDITURES (000 Omitted)	
	July 1-Oct. 31	Unobligated Balance, Nov. 1	July 1-Oct. 31	Unexpended Balance, Nov. 1
Aircraft, Engines, Parts				
Air Force	−283,929	9,155,771	1,750,310	13,589,566
Navy	249,602	3,045,179	546,501	5,476,086
Army	−60,790	300,110	32,424	447,119
MDAP	−9,188		10,648	470,363
TOTAL	−104,305	12,501,060	2,339,883	19,983,134
Guided Missiles				
Air Force	34,779	1,022,756	155,550	1,425,339
Navy	95,392	230,300	51,899	503,074
Army	108,714	330,936	85,815	919,291
TOTAL	238,885	1,583,992	293,264	2,847,704
Electronics & Communication Equipment				
Air Force	16,215	820,178	166,755	1,450,135
Navy	29,432	182,552	28,915	339,150
Army	7,086	189,257	32,559	535,528
MDAP	11,655		21,255	−2,269
TOTAL	64,388	1,191,987	249,484	2,322,544

Aircraft Employment Reaches 755,800

Employment in the aircraft manufacturing industry in October reached 755,800 of which 514,900 were production workers, according to the Bureau of Labor Statistics.

The Bureau reported an increase in employes during October for all categories of the aircraft industry: 489,300 workers with airframe builders, 144,900, aircraft engines and parts, 13,600, aircraft propellers and parts, and 108,000, other aircraft equipment.

The average work week also increased during the month to 41.4. Longer hours and a 2-cent rise in hourly pay brought the average weekly pay of aircraft production workers to $91.49, almost $6 more than in October 1954.

Democrats Ready Aviation Investigations

By Katherine Johnsen

Washington—The Democratic-controlled Congress has marked the Defense and Commerce Departments for frontal attacks in this Presidential election year, and the aviation industry will be in the midst of the battle.

The day after Congress opens—on Jan. 4—Sen. Mike Monroney (D. Okla.), chairman of the Commerce Aviation Subcommitte, has scheduled hearings on the firing of Fred B. Lee as Civil Aeronautics Administrator. Monroney has already made it clear that the hearings will go far beyond Lee's dismissal into charges that this was only one move in a general plan of Under Secretary of Commerce Louis Rothschild to control not only CAA but also the Civil Aeronautics Board. Monroney will also challenge the appointment of Joseph Minnetti on two grounds that he is dominated by Rothschild and that he is only superficially a Democrat. Under the 1938 Civil Aeronautics Act the Board position formerly held by Josh Lee must be filled by a Democrat.

Plan of Attack

The congressional attack on the Defense Department will take two tacks:

- **Failure to adequately increase** military strength in order to make budget savings so that the Administration could produce a balanced budget.
- **Failure to make** adequate savings in the defense budget by controlling the military procurement profits of big business. Rep. George Mahon (D.-Tex.), Chairman of the Military Appropriations Subcommittee, expressed the temper of the Democratic Congress last May, a temper held in abeyance until now.

"The profits of aircraft manufacturers have been soaring as though they were jet propelled.

"They have in some instances reached supersonic speeds. The taxpayer is being taken for a merry ride. . . . The Secretary of Defense is a genius in the field of business and management but if he has knocked any heads together in industry in an effort to get defense costs down to reasonable levels through better contracting I have not heard about it."

The Democratic attack on military profits contracts will be primarily aimed at the big business management of Defense Department, notably Secretary of Defense Charles Wilson, but defense contracts, primarily aircraft contractors, will also be investigated. Here is the investigation schedule:

- **House Armed Services Investigating Subcommittee** will open public hearings early in January, calling in each airframe manufacturer, aircraft engine manufacturer and major aircraft subcontractor to determine the results of Defense Department procurement policies on the profits and valuation of the companies. The expansion of the industry, necessary to achieve a 137-wing Air Force, has resulted in aircraft stock advances.

The subcommittee is headed by Rep. Edward Hebert (D. La.). It is being guided by Rep. Carl Vinson (D.-Ga.), chairman of the full committee and the congressional veteran on profits investigations, reportedly with the full approval of House Speaker Sam Rayburn (D.-Tex.).

The subcommittee says that its interest is to present to the public an over-all picture of the position of the aircraft industry as a result of Defense Department procurement policies.

- **The House Appropriations Military Subcommittee,** which will begin hearings on the Fiscal 1957 defense budget in closed sessions in February, has already announced one of its primary areas of questioning: the percentage profits of aircraft manufacturers based on net worth.
- **The Defense Department,** as a result of a congressional directive, is due to publish a listing of the 100 biggest defense contractors for the periods from January through June of 1955, and from July, 1950 (the start of the mobilization period), through June 1955. Investigations into the concentration of defense business are on the agenda of the Senate Preparedness Investigating Subcommittee headed by Sen. Lyndon Johnson (D.-Tex.), the Senate counterpart of the Hebert Subcommittee of the House. The Small Business Committees of both houses also are closely following the concentration of defense business.
- **Senate Small Business Committee** will open hearings on Thursday on its findings that Defense Department tends toward negotiated contracts and away from competitive bid contracts.

Democratic View

Sen. Stuart Symington (D.-Mo.), former Secretary of the Air Force, has taken, and undoubtedly will continue to take, the lead in Democratic criticism of the Administration for making military strength—Marine and Army ground forces with airlift support as well as USAF strength—a pawn to budget considerations.

Democrats, unimpressed with Defense Secretary Wilson's recent announcements that the new money

New "Anchor" for F-84-F

New drag parachute for F-84-F Thunderstreak fighter-bomber tugs back with a force of 8,000 lb. and helps stop the aircraft in 2,400 ft., 1,000 ft. less than the space required in normal landing without chute. The parachute is 16 ft. in diameter and trails 35 ft. behind plane.

Beech Tests Jet Version of Mentor Trainer

First Beech built jet—the Model 73 two-seat tandem trainer—designed and built by the Wichita, Kan., firm as a private venture, has started its flight trials. Based on the Model 45 Mentor (T-34), the Model 73 is powered by a Continental J69-T-9 of approximately 900-lb. thrust. It has a top speed of 253 knots at 15,000 ft., a stall speed of 60 knots and weighs only 4,521 lb. The Model 73 is designed to provide students with familiarization in aerobatics, night flying, basic instrument training in addition to dual instruction.

request for Fiscal 1957 will exceed Fiscal 1956 appropriations by $2 billion and that planned expenditures in Fiscal 1957 will exceed those of Fiscal 1956, view the situation this way:

• **Expenditures**, the Administration is holding these down in Fiscal 1956, which ends June 30, 1956, for the express purpose of paving the way for a balanced budget and tax reductions in the election year.

• **Appropriations.** With a big appropriation for Fiscal 1957 available July 1, 1956, the Administration will have a huge fund available for contracts in key locations during the crucial closing months of the 1956 presidential election.

On the matter of Defense Department holding down spending during Fiscal 1956, Democrats have this to show: During the first four months cancellations of aircraft contracts exceeded new contracts by $284 million.

The development occurred despite a report approved by House and Senate directing that obligations and expenditures for aircraft should be "accelerated to the extent possible consistent with proven technological developments and efficient application."

Three key senators on civil aviation face re-election this year, so far without opposition. They are:

• **Sen. Warren Magnuson** (D-Wash.), chairman of the Commerce Committee. Gov. Arthur Langlie and Under Secretary Commerce Walter Williams have been mentioned as possible Republican opponents, but neither has indicated any intention. Magnuson defeated Williams by a wide margin in the 1950 election.

• **Sen. Mike Monroney** (D-Okla.), chairman of the Commerce Aviation Subcommittee.

• **Sen. George Smathers** (D-Fla.), chairman of the Special Commerce Subcommittee on International Aviation. Former Sen. Claude Pepper, defeated by Smathers in 1950, has said that he will run for a Senate seat in either 1956 or 1958.

After the opening attack, led by Monroney and directed at Rothschild, the Commerce Aviation Subcommittee is scheduled to take up the following matters:

• **An independent Civil Aeronautics Administration.** Monroney has announced that he will sponsor legislation separating CAA from Commerce. The industry generally, including scheduled and non-scheduled airlines, are expected to take the position that upsetting the organization now would result in more harm than good. Air Line Pilots Assn., though, will support the independent CAA plan.

• **New Washington National Airport.** On this issue, Rothschild and Monroney are headed for another collision of view points. Rothschild wants to set up a tri-state authority to operate a second airport for Washington. Monroney takes the position that the delay involved in this would result in thoroughly inadequate facilities to meet the needs of a few years hence.

• **Less presidential authority.** Legislation limiting the President's authority to veto Civil Aeronautics Board decisions to the foreign relations and national defense aspects of international route cases apparently will have clear sailing through Congress.

The White House is understood to favor the measure. This would eliminate White House jurisdiction over routes to territories completely.

• **Permanent Alaska routes.** Magnuson will push legislation to give the two carriers—Pacific Northern Airlines and Alaska Airlines—permanent certificates. This will probably open consideration of permanent certificates for helicopter services. The committee took the position last year that there should be a further trial period for helicopter services before permanent certification.

• **Industry representation** on international bilateral airline negotiations. The special subcommittee headed by Smathers will hold hearings early in the session on the German bilateral agreement. A report calling for industry representation on international negotiations is expected. The recommendation already has the support of CAB Chairman Ross Rizley.

Air Force to Study Radiation Effects

A new atomic radiation test cell, which will be used to gain information about the behavior of aircraft materials and equipment under neutron and gamma ray bombardment, will begin operations within the near future at the Wright Air Development Center's materials laboratory. A maximum of 19,000 curies of gamma radiation (from the largest single source of Cobalt 60 in the country) can be imposed upon tested objects in the 18x7x12-ft. shielded working space. This could simulate the environment of equipment in the vicinity of the reactor of an atomic-powered aircraft.

Some of the effects of radiation which will be studied in the $140,000 facility:

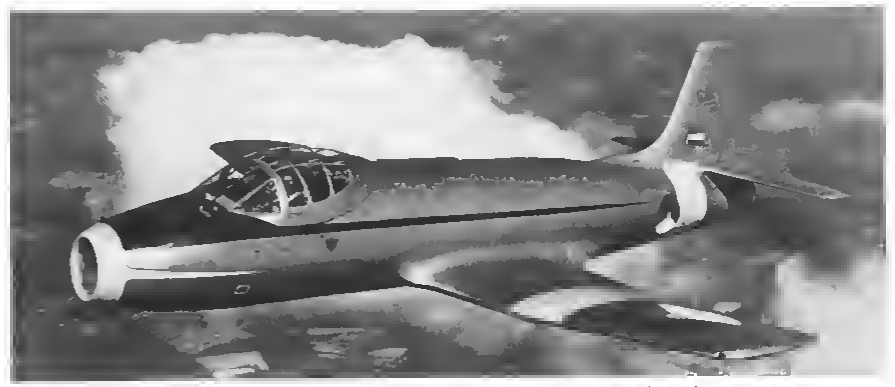
• **Tendency of lubrication oils** to change viscosity and carbonize.

• **Darkening and bubbling** of transparent plastics.

• **Interference** with the operation of transistors and gas filled tubes.

• **Deterioration of electrical insulation.**

• **New methods of vulcanizing rubber.**



S-14 Makes Second Bid in Jet Trainer Market

A second Fokker S-14 two-place intermediate jet trainer, possible rival of the Beechcraft Model 73, arrived in the U.S. late last month for a demonstration tour of Air Force and Navy training bases. The first S-14 brought to the U.S. by Fairchild Aircraft which holds a license to manufacture and sell the trainer, crashed in Hagerstown, Md. on Oct. 20. Powered by a Rolls-Royce Derwent "8" centrifugal flow gas turbine engine with 3470 lb. thrust, the S-14 has a top speed of 450 mph.

European Aviation Group Forms, Plans to Increase Air Traffic

First session of the European Civil Aviation Conference ended last month at Strasbourg, France, with agreement on a constitution and future working methods.

The constitution provides for the conference to call its own meetings and fix its own agenda. It will hold annual plenary sessions, the main task of which will be to review the development of intra-European air transport in order to promote coordination, better utilization and an orderly development of traffic.

Close liaison will be maintained by the Conference with the International Civil Aviation Organization. Financial arrangements for the conference will be considered at a meeting to be held concurrently with the 10th session of the ICAO assembly at Caracas, Venezuela, in June 1956.

Representatives from 18 European countries met at the first session of the conference, which was called by ICAO on Nov. 28, 1955. The conference elected Pierre Nottet of Belgium as president, and Luis de Azcarraga of Spain, Alf Heum of Norway and Antonin Ambrosini of Italy as its three vice presidents.

First order of business was a discussion of the need for standardization of regulations and a streamlining of economic arrangements in Europe. Three reasons were advanced in support of better coordination and liberalization of the European air transport system:

• **Frequency of services** is still relatively low on European networks.

• **Utilization of aircraft** is lower than on the U.S. domestic routes.

• **Revenue-producing ability** of European airlines is considered poor.

A lengthy exchange of views took place in connection with a multi-lateral agreement for intra-European scheduled services and recommendations for an orderly solution of the problems involved in the interchange of aircraft and in helicopter services.

The conference prepared a draft multi-lateral agreement for solution of the problems involved in the organization of the non-scheduled services in Europe. This agreement would establish freedom of operation for non-scheduled European airlines in the following categories:

• **Aircraft engaged** in humanitarian or emergency missions.

• **Transportation** of passengers in air taxis—minimum seating capacity of six passengers.

• **Charter flights** when there is no resale of space.

• **Any flights** which have a maximum frequency of once a month.

• **All freight and passenger** operations between regions which have no reasonably direct connection by scheduled services.

The delegates were split on how to substitute a multi-lateral agreement in place of the present bilateral agreements in Europe for exchanging commercial rights of intra-European scheduled air services.

Some delegations emphasized that more promising immediate results could be obtained by concentrating on "cooperation between airlines" and that the role of governments should be limited to the facilitation of such cooperation. They pointed out that, in fact, some major airlines already have made considerable progress in cooperating during the last 18 months.

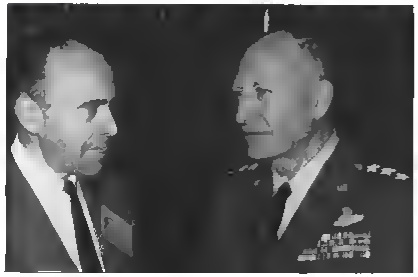
Other delegations expressed the opinion that cooperation "in the two levels of governments and airlines" is the policy which would best obtain the greatest improvement in the situation. They wanted a formal declaration by the states that were represented that they favored direct services between states and would refrain from opposing the establishment and operation of air services of other member states unless they considered such services actually harmful to their own national airlines or decided that they did not serve the best interest of the users.

The conference also exchanged views on the problems raised by the development of helicopter services and heliports. It was decided that improvements are needed as far as operating economy, safety, all-weather operation and noise reduction are concerned. The question of helicopter services will be on the agenda of the next ICAO air navigation meeting in the European-Mediterranean region.

Regarding the interchange of aircraft, the conference proposed an examination by a "study group."

TNE RECENT ARDC-Industry Conference in Baltimore was attended by 450 persons Among them, l. to r., W. J. Pattison, Garrett Corp.; W. H. Wilson, Hazeltine Electronics Corp.; W. E. Barbour, president, Tracerlab Inc.; Rear Adm. W. A. Schoech, BuAer

ARDC-Industry Conference



LT. GEN. CLARENCE S. IRVINE, USAF Deputy Chief of Staff, Materiel, and Ed Wells, Boeing Airplane Co. representative, meet during conference recess.

ARDC REPRESENTATIVE Maj. Gen. Floyd B. Wood, Deputy Commander for Research and Development. Others in picture are l. to r. Tad Stanwick, American Machine and Foundry Co.; S. N. McDonnell and J. S. McDonnell, president of McDonnell Aircraft.

Prop Phasing Cuts Noise in Transports

A new answer to the problems of cabin noise and vibration is being provided by the nation's three manufacturers of large propellers—United Aircraft's Hamilton Standard Division, Allison's Aeroproducts Operations and Curtiss-Wright's Propeller Division.

The new development not only keeps all propellers turning at the same rpm (the basis of prop synchronization), but keeps them in a specific angular relation to each other. It is called Synchrophaser, Phase Synchronizer and Synchrophasing Device, respectively, by the three companies.

Hamilton Standard says Synchrophasing provides two major benefits. It appreciably reduces cabin noise and vibration, and also makes residual noise more acceptable to the human ear. Instrumented flight tests with Synchrophasing on a Super Constellation and a DC-7 showed cabin noise reductions of as much as 16 decibels, according to Hamilton Standard. On a Convair 340, noise reduction varied from four to 15 db. through the cabin. Personnel aboard a test plane thought the reduction in vibration was more soothing than actual noise reduction, the company says.

Synchrophasing will be installed on Trans World Airlines' new 1649A Super Constellations. The Aeroproducts' Phase Synchronizer system is going into American Airlines' and Eastern Air Lines' turboprop Electras.

Here is how Hamilton Standard's Synchrophaser works:

One propeller is selected as a master and the other three (on a four-engine ship) are slaved to it.

A magnet is installed on each propeller and a coil in each engine nacelle. When a magnet passes a coil, it sets up a voltage pulse. This impulse travels to an electronic control which compares the time of the impulses from each nacelle. If the timing of the pulses differs from that of the master propeller, the difference is registered and corrected, keeping propellers in phase.

The synchrophaser has a range limit of 20 rpm. to prevent slave props from stopping in case of master engine failure. Hamilton Standard says the device will maintain phase relationship within 15 deg. Weight for a four-engine installation is 60 lb.

Hamilton Standard says it originally developed Synchrophasing 10 years ago, logging more than 500 hours on a Navy PB4Y, but shelved the idea because of lack of customer interest. The project has been revived now because of the increased noise and vibration problems stemming from today's more powerful engines and larger propellers.

Triple duty...*on the double!*

HERE'S A TYPICAL DAY'S WORK BETWEEN NAVAL AIR STATIONS FOR THE CONVAIR-BUILT R4Y, THE THREE IN ONE TRANSPORT THAT CONVERTS IN MINUTES!!!

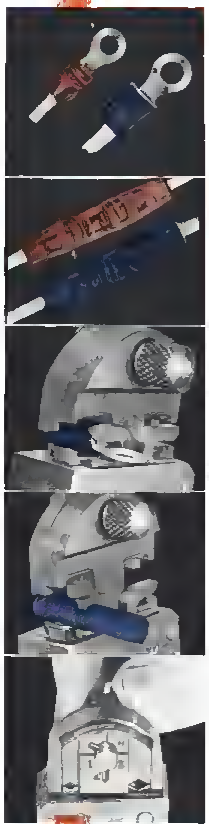
RAY 994 0600 44 PASSENGERS NORFOLK TO MEMPHIS••• =

1245 12500 LBS HIGH PRIORITY CARGO MEMPHIS TO NEW ORLEANS•••

EW RAY 1730 21 LITTER PATIENTS NEW ORLEANS TO CHICAGO•••

CONVAIR A DIVISION OF GENERAL DYNAMICS CORPORATION

built for the hands that build airplanes



T-HEAD HAND TOOL
for pre-insulated terminals & connectors 22-16 and 16-14

Here's the one hand tool that works on 80% of all aircraft wiring. AMP's new T-Head Tool crimps terminals and connectors in both 22-16 and 16-14 wire size ranges. Crimping jaws are color coded to match AMP color coded terminals and connectors and each crimp is branded with AMP's Proof-mark of Quality.

A special take-up device holds terminals and connectors firmly for one handed operation of the tool. Then AMP's Certi-crimp ratchet takes over and prevents the tool from being opened until the crimp is completed. The tool is adjustable for all aircraft wire insulation thicknesses and is balanced for less operator fatigue regardless of the size of the operator's hands.

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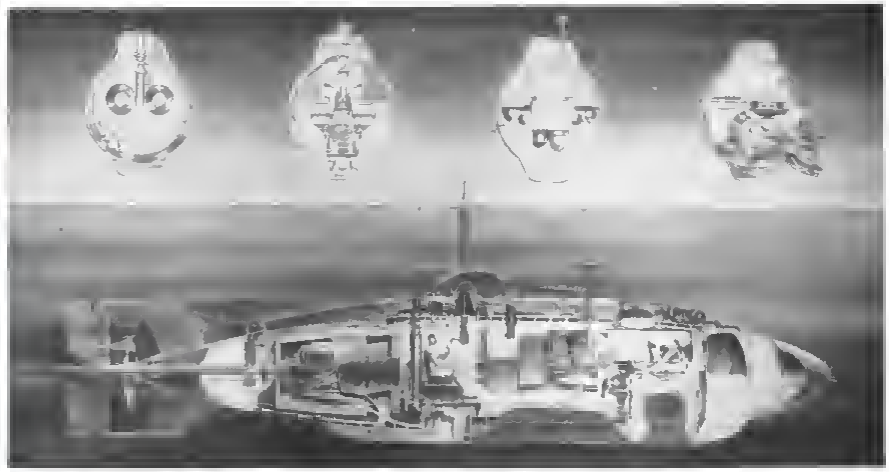
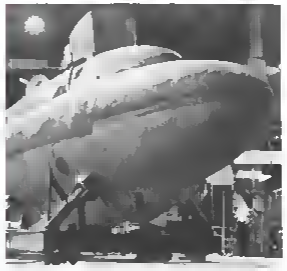
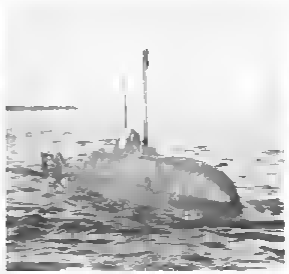
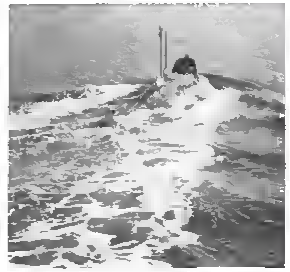


X-1 CROSS SECTION panels at top show, 1 to r., engine room bulkhead, aft cabin area, forward cabin, underwater swimmer's tank.

USS X-1, Fairchild's Midget Submarine

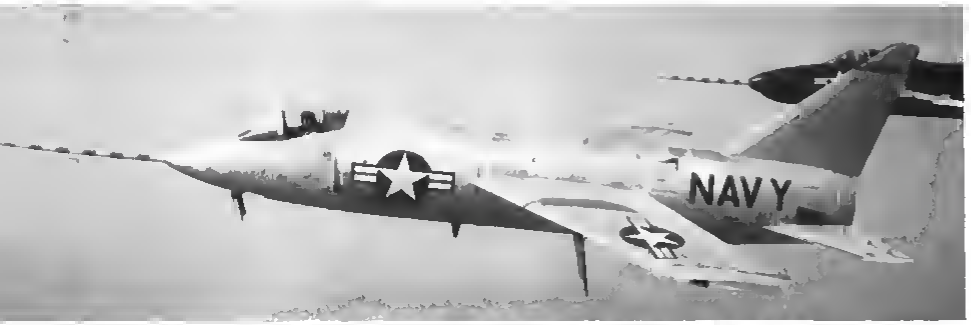






THE NAVY'S FIRST midget, with airplane-like dual controls, was built in aircraft hangar, left, and tested in Long Island Sound.

X-1, shown above in first submersion test, can be disassembled for air transport. Primary use will be to test harbor defenses.



ORIGINAL TIGER, then designated F9F 9, was designed according to the area rule, and was supersonic in level flight.

LATEST TIGER, redesignated F11F-1, shows longer nose, revised canopy and duct inlet and new vertical tail.

New Design Changes on Navy's Supersonic F11F Tiger

Latest detail design changes in the F11F-1 Tiger reflect Grumman's continuing experimentation with the supersonic fighter.

Most obvious recent alteration is in the geometry of the vertical tail, which has now a reduced taper ratio and overhangs the tailpipe exhaust.

Wing fences, which originally extended from leading edge to just ahead of the spoiler lateral control system, now start well behind the leading edge, about on the extended trailing edge of the droop-snoot flaps. Shape of the fences now is trapezoidal.

Third airplane off the line (No. 138606) has been assigned to Grumman's Experimental Dept. for development work. Current configuration of the plane, which is also the latest production layout, is shown on this week's cover.

That aircraft also has been flown with and without wing fences, the four 20-mm. cannon and the new vertical tail.

Earlier changes made to the Tiger's area-ruled shape include:

- **Lengthened nose,** for increased fineness ratio and reduced drag.
- **All-clear canopy,** replacing the experimental unit which had a metal afterbody.
- **Revised duct inlet contours,** with a boundary-layer separator plate added.

The experimental Tiger first flew July 30, 1954, before its fourth flight, which was a public demonstration (AW Aug. 16, 1954, p. 38). The plane had been supersonic under the control of project pilot C. H. (Corky) Meyer.

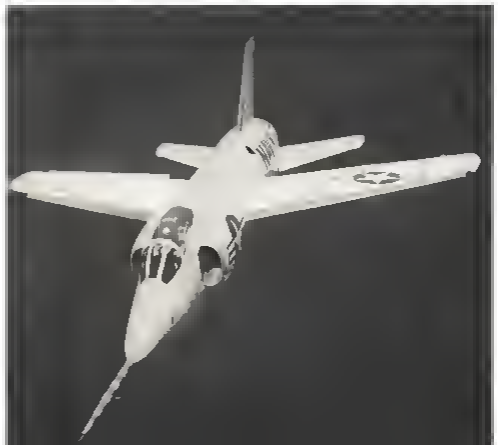
Birth of the Tiger resulted during an engineering staff meeting early in January 1953. By April the Navy had written Grumman a letter of intent, and Design 98 was underway. Assembly was well advanced by March 1954, and the first complete Tiger went from the experimental shop to the hands of the hangar crews on July 19. Production has continued since.

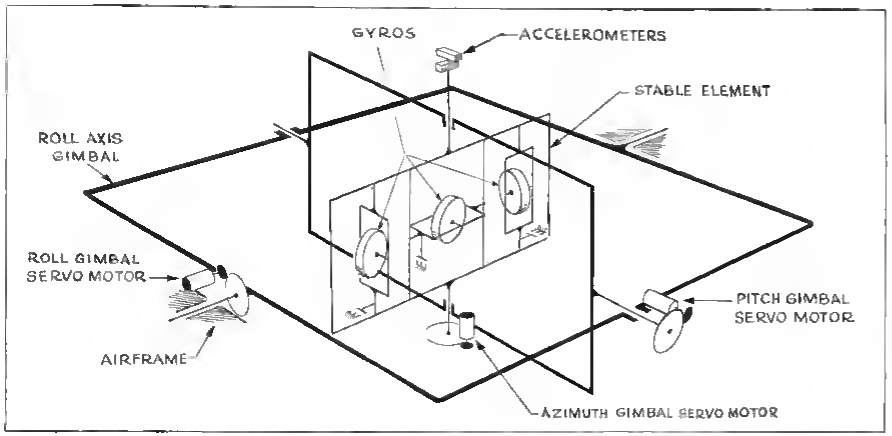
SPOILER UP, the Tiger rolls away (at right). Control system was developed for the Panther F9F-6, later adapted for the Tiger.

FENCELESS Tiger (below) was one stage of aerodynamic development of the fighter.

FENCED Tiger (bottom right) is now standard configuration, with fences extending only over part of the wing chord.

VENTED WING of rolling Tiger is caused by raised spoiler on upper surface of wing and retracted gate on lower surface.





GYRO STABILIZED PLATFORM and linear accelerometers shown schematically above, form heart of all known inertial guidance systems.

Inertial Navigation: Out of the Laboratory into Missile Systems

By Philip Klass

Inertial guidance, the automatic navigation technique which will guide the intercontinental ballistic missile to its target, is moving rapidly from the laboratory stage into operating hardware.

Although originally developed for use in long range missiles, such as the North American Navaho, and piloted aircraft, an adaptation of the inertial guidance technique may find future use in overseas airliners and short-haul helicopters.

Inertial type of guidance and navigation systems offer several significant advantages:

- Invulnerability to enemy jamming.
- No ground facilities required.
- No radiation emitted, preventing enemy detection.

With the present state of the art, an inertial system may weigh anywhere between 75 and 2,000 lb., depending upon its intended use, required accuracy and duration of the mission.

Although many of the basic inertial system components such as gyros, accelerometers, computers and servo systems, have long been used aboard aircraft, these familiar devices are a far cry from those required for inertial navigation systems.

The instrumentation accuracy needed to give inertial guidance systems even moderately acceptable performance is equivalent to the extreme precision normally found only in research laboratory standards. However, an airborne inertial guidance system must operate in the extremes of temperature, vibration and shock encountered in high-speed aircraft and missiles.

There can be little doubt that the art of inertial guidance instrumentation has made significant strides in the past several years although details on specific devices are obscured by military security. With an increasing amount of the nation's top scientific effort going into inertial developments, even more progress can be expected in the next several years.

One evidence that inertial systems are fast coming of age is the growing number of companies and organizations now active in a field which did not even exist 10 years ago. Today, the list includes AC Spark Plug, American Bosch Arma Corp., Bell Aircraft Corp., California Institute of Technology's Jet Propulsion Laboratory, Dynatrol Corp., Federal Telecommunications Laboratory, General Electric, General Precision Laboratories, Kearfott, Litton Industries, Massachusetts Institute of Technology, North American Aviation and Sperry Rand.

North American's Autonetics Division and MIT's Instrumentation Lab under Dr. C. S. Draper, are two of the oldest groups in the inertial field. MIT generally is considered a fountainhead of know-how in the field, and several firms like AC Spark Plug and Minneapolis Honeywell, work closely with Draper, converting MIT ideas into production hardware.

In addition, there are many other companies which are developing and/or producing inertial guidance sub-systems and devices, such as stabilized platforms, gyroscopes and accelerometers. Lear and Eclipse-Pioneer are in this category.

Any inertial navigation system is essentially a form of dead reckoning device. This means that the geographic position (latitude and longitude or equivalent) of both the starting point and destination must be known and must be set into the equipment.

It also means that inertial guidance cannot be employed against a moving target unless another type of target seeker is used in the final homing phase of the attack.

Once the information on starting point and destination has been inserted, and the inertial system has been placed in operation, it is capable of determining and providing the following information:

- Geographic position of the vehicle.
- Ground velocity and track.
- Distance traveled and distance to destination.
- Direction to destination.
- Attitude of the aircraft or missile.

No Simple Dead Reckoner

With such information, it is relatively easy to design the system to provide control signals which can be fed to the aircraft or missile's automatic pilot to automatically fly it to its destination.

Inertial guidance should not be confused with automatic dead-reckoning (DR) computers, which have been in operational use for some years. These provide somewhat similar information, but arrive at the solution using entirely different inputs. This type of DR computer is typified by the AN/ASN-6 made by Ford Instrument Co. and similar devices made by Loral Electronics Corp., Eclipse Pioneer and others.

The ASN-6 type of DR computer works from essentially the same information which a pilot or navigator would use if he were working out the problem manually. Airplane speed is obtained from a conventional airspeed indicator, modified by external wind velocity which is set in manually or automatically by means of a Doppler or other type radar.

Automatic DR computers which employ Doppler/TM radar to measure ground speed are being produced by General Precision Laboratories (AN/APN-66) and Ryan Aeronautical Co. (AN/APN-67). The radar-measured ground speed is integrated as a function of time to provide aircraft displacement from the starting point, and this in turn is resolved into its north-south and east-west components.

Without such a radar (ground speed) input, a DR computer is dependent upon an accurate source of static-pitot pressure for accurate airspeed measurement. This is difficult to obtain on high-speed aircraft and missiles. Furthermore, accurate and continuous information on the velocity and direction of winds aloft is practically impossible to obtain without external radiation to measure drift or ground speed directly with the consequent dangers of jamming and detection.

The inertial navigator, on the other hand, substitutes an entirely different technique of measuring aircraft displacement, which eliminates the need for measuring indicated airspeed and wind velocity or drift.

Inertial Fundamentals

An inertial system is able to determine the displacement of the carrying vehicle from its starting point by measuring the accelerations of the vehicle relative to the earth. It is possible to measure these accelerations because of the forces that result on the vehicle and its inertial instrumentation.

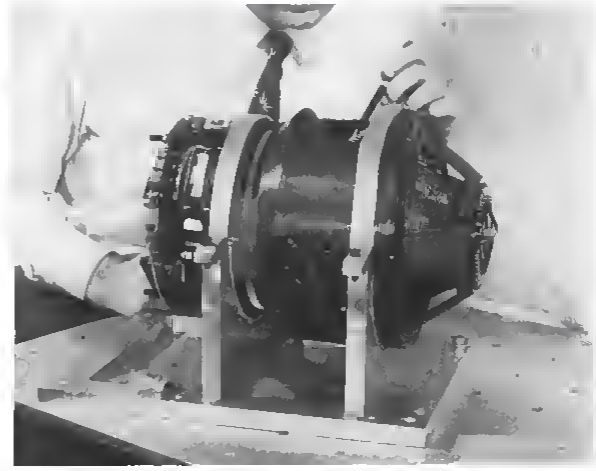
Velocity is the rate of change of distance with time, and acceleration is the rate of change of velocity with time. By a reverse process, if a vehicle's acceleration relative to the earth can be measured, a double integration of this acceleration over a time interval will give the total distance which the vehicle has traveled during that interval. Mathematically, this can be expressed:

$$Dist = \iint (a)\,dt^2$$

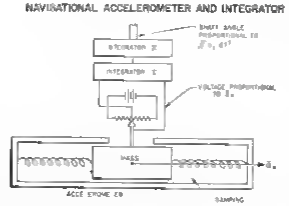
Suppose for example that an automobile starts from rest, accelerates uniformly at 10 feet/sec/sec and then continues at a constant velocity. At the end of five seconds, the car will have covered a total of 125 feet and then will be traveling at a constant speed of 50 feet/sec.

If the car were equipped with a device capable of measuring acceleration in the direction of the car's motion, consisting of a spring restrained mass as shown schematically (left), the signal generated by this "accelerometer" would be proportional to the car's acceleration.

If this signal were fed to an "integrator," a device which effectively multiplies the acceleration by its time of duration, the output signal from this integrator would be proportional to the car's velocity, or 50 ft/sec in the example cited. If this signal should be supplied to a voltmeter, suitably calibrated in feet, it would indicate the



STABILIZED PLATFORM, made by Eclipse Pioneer. Smaller units have been developed



ACCELEROMETER output is twice integrated to determine distance vehicle travels.

First of a Series

Inertial navigation is a new technique for automatic and semi-automatic guidance of long-range missiles and aircraft. Because of the extreme precision required, the development of inertial components and systems is one of most challenging design problems to be found anywhere.

The first authoritative and comprehensive discussion of the fundamentals of inertial guidance and report on its present status has been prepared by Aviation Week's avionics editor. The current article, dealing with basic fundamentals of inertial guidance, is the first of four on the subject.

Subsequent articles will deal with:

- 84-minute pendulum and its application to inertial guidance.
- Inertial components, their design techniques and problems.
- Hybrid systems which combine inertial and other navigation techniques.

SWITCHING
SAMPLING
SEQUENCING
HIGH SPEED
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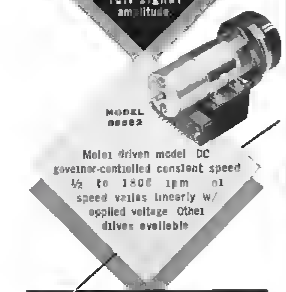

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distance traveled, just like existing odometers now used in automobiles.

Basic Inertial Components

Accelerometers and integrators, sometimes combined into a single device, usually form the basic sensing elements of all inertial navigating systems. A system designed for use in an aircraft or missile, which has more than one degree of freedom of movement and which may fly in a variety of attitudes, involves much more complexity and sophistication than the simplified automobile inertial navigator cited above.

For example, an airborne inertial system usually requires:

- **Two or three accelerometers** to sense aircraft/missile motion in the north-south direction, east-west direction and, in some applications, in the vertical direction. These accelerometers must be extremely accurate over a wide range of acceleration values, covering a range of "several hundred thousand to one," according to one expert in the field. Associated with, and sometimes a part of the accelerometer, is an integrator for summing up accelerations as a function of time.
- **A gyro-stabilized platform** upon which the accelerometers are mounted, to maintain them in a horizontal position despite changes in vehicle position and attitude. In this respect, the stabilized platform may be viewed as a "miniature airplane" whose attitude and heading is stabilized by a conventional automatic pilot.

Because an accelerometer cannot distinguish between vehicle accelerations (which it should measure), and gravity acceleration (which it should ignore), even a slight out-of-horizontal position of the accelerometer platform can introduce serious errors. The platform must also keep the accelerometers properly oriented in azimuth relative to their respective north-south and east-west axes or other coordinate system employed. Extremely high-performance servo systems are needed to maintain the platform stabilized to the required accuracy.

- **A spherical-trigonometric computer,** capable of converting distance traveled into corresponding changes in latitude and longitude for the particular latitude of the aircraft/missile. For example, a distance of 60 nautical miles at the equator corresponds to one degree of longitude, but is equivalent to 1.4 degrees at a latitude of 45 degrees. The computer also functions to compute the distance and required heading which must be flown to the destination.
- **Special corrections** must be introduced to compensate for the fact that the earth isn't a perfect sphere, being somewhat flattened at its poles. The fact that a correction must be introduced for this difference in earth radius, which is only 13 miles in nearly 4,000, is one indication of the accuracy required in inertial guidance. Another correction is required for what is called "Coriolis effect"—because the vehicle is navigating about a rotating earth. Other compensations may be required in certain types of systems for the vehicle's vertical velocity and height above the earth.

These then are the basic building blocks of inertial systems. They can be combined in a variety of ways, several of which will be considered in some detail in subsequent articles in this series.

Typical Airborne System

These building blocks might be assembled into an airborne inertial system for long range aircraft which would operate in the following manner.

East-west and north-south accelerometers would be mounted on a platform which has three degrees of freedom (see sketch, p. 32). It can rotate one of its gimbals about the plane's roll axis, another about its pitch axis, and a third about its yaw (azimuth) axis.

Two or three gyros, depending upon the type used, would be mounted on the platform to detect motions of the plane about the roll, pitch and yaw axes.

When the plane's attitude or heading changes, the gyro signals will cause servo system motors to move the appropriate platform gimbal so as to prevent displacement of the accelerometers from a horizontal plane.

To start up the system, the stabilized platform is erected to the horizontal, aligned in azimuth so that the sensitive axis of the N-S accelerometer is pointed north-south, which also orients the E-W accelerometer. The latitude and longitude of the starting point and destination is then set into the system, and the integrators are trimmed to zero.

As soon as the aircraft begins its takeoff run, the accelerometers will sense the resulting accelerations. Each accelerometer signal is integrated twice, to provide distance covered in the N-S and E-W directions. These distances then are converted into corresponding changes in latitude and longitude and added to the starting point coordinates to show the plane's new position.

Spurious Gravity Acceleration

If the earth were flat, the system described would operate satisfactorily, assuming no drift in the gyro references. However, the fact that the earth is spherical, and that gyros attempt to maintain their position (and that of the platform) stabilized in space raises a problem: how to keep the platform always in a horizontal position as the plane or missile moves around the earth so that the accelerometers will not measure the spurious gravity acceleration.

A similar problem is encountered in a conventional aircraft horizon gyro, which must maintain its axis vertical despite movement of the plane and the tendency of the gyro to drift.

Here the problem is solved by using a small pendulum (or similar device) which serves as an accelerometer to determine the direction of vertical, and to keep the gyro axis aligned in this direction.

However, as every pilot knows, when the airplane goes through turning maneuvers for an extended period of time, the horizon gyro displays a false vertical indication. The reason is that during the turn, the gyro pendulum is subjected to centrifugal accelerations which cause it to "think" that gravity (the vertical) has been displaced. The gyro then aligns its spin axis to this spurious vertical position.

Although a simple erecting pendulum can be used in slow-speed aircraft, it is not satisfactory for high-speed planes and missiles.

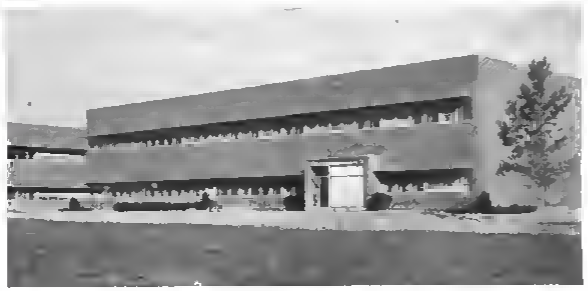
Error Build-Up

Another serious problem which exists in the simplified inertial system described above is its build-up of errors with time. Because computed distance is proportional to the second power of time, it would appear almost impossible to obtain accelerometers, gyros and integrators with sufficient accuracy to prevent an intolerable build-up of errors during a long mission.

To lick this critical problem and the associated problem of maintaining the platform horizontal at all times, inertial systems designers have turned to an idea conceived more than 32 years ago by a German professor of applied mechanics, Dr. Maximilian Schuler.

Schuler first described his idea in print in Physik. Zeitschr. in 1923, in an article entitled "Aberration of Pendulum and Gyroscope Instruments Due to Acceleration of the Transporting Craft." This principle, now known as the "Schuler pendulum," "84-minute pendulum," or "earth's pendulum," forms the heart of all known inertial systems under development today.

The theory of the Schuler pendulum, and its application to inertial systems, as well as the operation of a typical system employing this principle, will be described in the second article of this AVIATION WEEK series.



New GE Computer Building

New $650,000 computation building recently completed by General Electric will house large digital computers used by GE's jet engine facility at Evendale, Ohio. Building will house two new Model 704 computers rented from International Business Machines Corp. at an annual fee of nearly $1 million. GE calls its new facility "the first permanent building in American industry designed to house giant electronic computers."

FILTER CENTER

►**Electronics Mushrooms** — Everyone agrees that the electronics business will mushroom in the next decade. For instance:

- **Double in five years,** says General Electric's president Ralph J. Cordiner.
- **$15 billion by 1960 and $20 billion by 1965** is the prediction of Don G. Mitchell, chairman and president of Sylvania Electric Products, Inc.

►**New Silicon Transistor Source**—Texas Instruments' two-year "monopoly" on silicon transistors will be broken next month when Raytheon announces that it is in production on high-temperature silicon transistors. The Raytheon units will be p-n-p types made by a diffusion alloy process, in contrast with Texas Instruments' rate-grown n-p-n silicon transistors.

►**Bigger Memories**—A high-speed magnetic core storage, which increases the memory of the IBM 704 computer by 700% (32,768 words), has been announced by International Business Machines Corp. Random access time to

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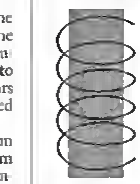

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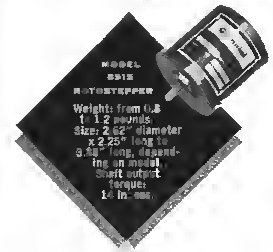

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any one of the 36 bit words requires only 12 microseconds with the new Type 738 magnetic core storage. All words in the storage unit are directly addressable from the 704, IBM says. Another similar type of magnetic core storage can be used to add 20,000 seven-bit words storage to the IBM 705.

▶**Crystal Ball Polished Off**—Dr. W. R. G. Baker, vice president in charge of General Electric's Electronics Division has come up with the following preview of things to come during 1956:

• Electronics will become a more vital link in the overall weapons concept of defense with greater emphasis on re-

Dr. W. R. G. Baker

liable control, guidance and navigation of airborne weapons.

• Transistors will make "a major breakthrough" in devices for military, civilian and industrial use. New higher frequency and higher power transistors can be expected.

• Encapsulated resistor-capacitor assemblies will be used more widely for easier assembly into end equipments.

• New micro-miniature ceramic tube types (AW Oct. 17, 1955, p. 71) will be introduced.

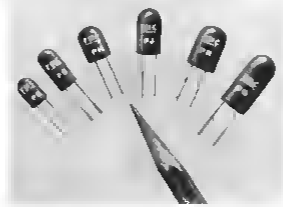
▶**No Government Inspection**—National Fabricated Products division of Hoffman Electronics Corp., maker of tube sockets and terminal strips, has been granted permission to ship its components without government inspection. The action followed a survey which showed that the outgoing quality level was "well within" the 1% AQL established by the Chicago Air Procurement District.

▶**New Noise Measurement Techniques**—The National Bureau of Standards reports it has developed a new method to obtain an objective, reproducible "noise index" for instrument cables subjected to shock, vibration or transient pressures. The new technique was developed by the bureau's T. A. Perls under Defense Department and Atomic Energy Commission sponsorship.

NEW AVIONIC PRODUCTS

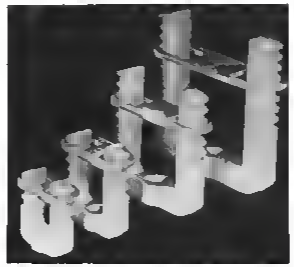
Components & Devices

• **Miniature precision resistors,** wire wound, Type P, are specifically designed for use with printed wiring boards. Both leads project from one end and units require no support other than that obtained from leads. Resistors can



be operated at rated load at temperatures up to 125C, and come in ratings of 0.1 to 1 watt, are available with resistances of 0.4 to 3 megohms, with tolerances of 0.05 to 1%. Resistors reportedly meet MIL-R-93A, Amendment No. 3. Resistance Products Co., 914 S. 13th St., Harrisburg, Pa.

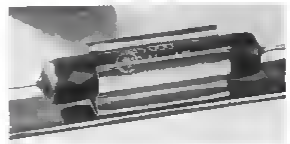
• **Cable harness clamp,** Type 2C1, eliminates tying of bundles of wires, permits quick changes in wire routings. The U-shaped clamp and keeper is



made of molded nylon and can be operated at 250F. Clamp comes in range of sizes from ⅜ to 2¼ in. wide. Dakota Plastics Co., 810 N. Mayo Ave., Compton, Calif.

• **Rotary solenoid** with adjustable return spring is now available in two basic models, the BD3 and BD5. Return spring torque can be set to very close limits. New bulletin gives mounting dimensions and standard spring torsion values. G. H. Leland, Inc., 123 Webster St., Dayton, Ohio.

• **Silicone-coated precision power resistor,** Type 'S', wire-wound, is suitable for clip-type mounting which permits



up to 50% increase in power capacity. Manufacturer says silicone coating is not affected by high ambients or thermal cycling. New Silcohm resistors are available with ratings of 2 to 10 watts in tolerances ranging from 0.05% to 3%. Sage Electronics Corp., Rochester, N. Y.

• **High temperature miniature servo motor,** Type 171, is designed for minimum life of 1,000 hours of continuous operation at temperature of 150C, with shorter life at 180C. Motor measures 1⅛ in. diameter and weighs 3 oz. Input voltage is 115 v., stall torque is 0.4 oz.-in., no load speed is 7,200 rpm., and rotor inertia is 1.2 gm-cm². Servomechanisms, Inc., Components Div., 625 Main St., Westbury, N. Y.

Production Line Testers

• **Transistor tester,** Model T-62, checks the characteristics of point contact or junction type transistors, low or high power (up to 50 watts), in either common emitter or common-base connection. Tester provides direct readings of small signal parameters as well as static characteristics. All power supplies are included. Scientific Specialties Corp., Snow & Union Streets, Boston 35, Mass.

• **Diode tester,** Model DT-100A, measures static characteristics of germanium and selenium diodes. Unit provides forward voltages of 0.05 to 2.0 v. d.c., up to 500 ma., and reverse voltages of 0 to 150 v. d.c., up to 5 ma. Reverse control has three-preset positions for rapid checks at 10, 50, and 100 volts. An accessory oven permits diode testing at elevated temperatures. Teletronics Laboratory, Inc., 54 Kinkel St., Westbury, L. I., N. Y.

Instrumentation

• **Pressure transducer,** Model P-1, magnetic reluctance type, is available in full scale ranges of 0.25 to 100 psi, gage or differential. Accuracy is quoted at 1% full scale. Unit is constructed with stainless steel housing, weighs 13 oz., measures 1¾ in. dia. x 2¼ in. long. Pace Engineering Co., 6914 Beck Ave., North Hollywood, Calif.

• **Miniature pressure transducer,** flush-mounted type, Model AP-17, is available to cover ranges of 0.15 psia to

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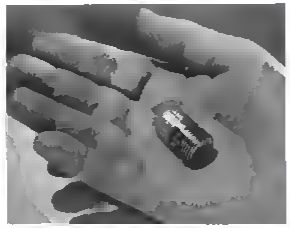
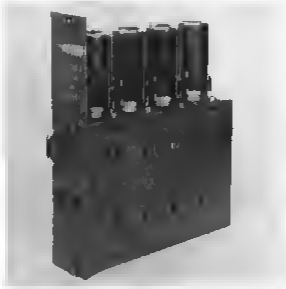


0-5,000 psia, with a natural frequency of 5,000 cps. Maximum acceleration sensitivity reported is 1% per 100G in the 0-15 psia range. Unit measures ¾ in. dia. x 1⅜ in. long, weighs 1½ oz. Transducer employs bridge circuit which delivers 0.8 mv/volt full scale at 10 volts maximum, 3,000 cps excitation. Excitation frequencies up to 20 kc. can be used. Calibration change with temperature is 1% full scale/100F over temperature range of −65F to 250F. Overall accuracy is better than 1% full scale. North American Instruments, Inc., 2420 North Lake Ave., Altadena, Calif.

• **Special-purpose receiver,** Type 1670, available in four models covering the 55-260 mc, and 55-260 mc bands, for use in telemetering, radiosonde reception and missile monitoring. Receivers have a 500-kc. bandwidth, discriminator linearity of 150 kc. minimum and a video frequency response of 20 cps to 100 kc. All models have choice of fast or slow automatic frequency control (2½ or 10 milliseconds). Nems-Clark, Inc., 919 Jesup-Blair Drive, Silver Spring, Md.

• **Pulse-width keyer amplifier,** Model DKA-1, is for pulse-width multi-coding and direct recording of data onto a single track of an Ampex tape recorder. DKA-1 combines standard 900 sample/second pulse-width keyer and a record amplifier in a single unit which is interchangeable with the FM or PWM/AM record strips in the new Ampex 800 Series airborne tape recorder. Unit weighs 1½ lb. Applied Science Corp. of Princeton, P.O. Box 44, Princeton, N. J.



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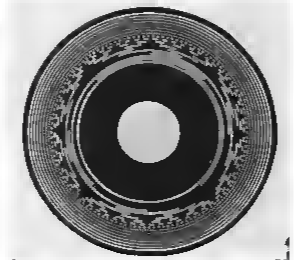


New Materials for Metal Cutting Hold Promise of Production Gains

Two recent developments in cutting tools may bring production benefits to the aviation industry. Tests show that:

• **Ceramic tool bits,** made of non-strategic materials, can be used at higher machining speeds than conventional tools.

• **Titanium diboride** gives indications of being very successful for high-speed machining of hard, high-temperature metals.

Ceramic Tools

The ceramic tooling development has been carried on by Norton Co., Worcester, Mass., in cooperation with the Rodman Laboratory of Watertown Arsenal, Mass.

To date, Watertown Arsenal's tests have been on SAE 4140 and 1020 steels, cast iron and brass. Pratt & Whitney Aircraft is investigating ceramic tools for tough, high-temperature metals that have proven difficult to machine.

The Norton development based on earlier research in Germany and Great Britain, takes advantage of those properties where ceramics are superior to conventional materials, while minimizing those where it is inferior.

Some ceramic materials (such as aluminum oxide) are harder, have greater temperature strength and wear resistance than metallic tool compositions. Their tensile strength at room temperature, ductility and shock resistance are generally inferior to those of carbides and high-speed steels.

In tests at the Watertown Arsenal, ceramic tools made of Norton's Alundum (aluminum oxide) have been used at speeds twice as high as those indicated for commercial carbides, grade C-6 and C-7. A cutting speed as high as 1,800 feet per minute showed no detrimental effect on the ceramic tool, Norton says, and even higher speeds are anticipated when machine tools with greater power become available. Because of the high rate of stock removal, high powered equipment is needed—in one test run, a single-point ceramic tool drew as much as 30 hp.

In one Watertown test at a cutting speed of 1,000 fpm., 0.10-in. feed, ¼-in. depth of cut, the ceramic tool remained cool to the touch after 20 in. of tool travel, cutting dry. The color of the chip also indicated a lower temperature than for a corresponding chip size removed by metallic tools under conventional conditions, Norton says. At maximum speeds and feeds, molten chips have been produced without affecting the ceramic tool. Furthermore, the ceramics have cut cast iron containing sand holes without chattering or breaking down.

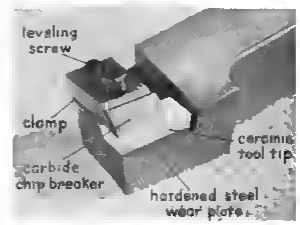
Aluminum oxide occurs naturally in a very hard and dense form as emery, corundum, sapphire and ruby. Mechanical properties approaching those of the natural forms can be obtained from material processed from refined bauxite. Properties of the natural forms include compressive strength of 400,000-450,000 psi., transverse rupture strength of 40,000-45,000 psi., tensile strength of 30,000-40,000 psi. and melting point of 3,720F.

Methods of processing the aluminum oxide powder include hot forming or pressing (after which no further operation is required) and cold pressing, slip casting and extrusion (followed by sintering or firing).

For most efficient use of the ceramic bits, special attention has to be paid to tool-holder design and tool shape. The tool holder must give maximum support of the cutting tool, with clamping forces evenly distributed to minimize stress concentration. An adjustable mechanical chip breaker must be used to protect against fatigue. Overhang must be minimized to reduce deflection and bending stresses.

Because of the exceptional heat resistance of the Alundum ceramic tools, blanks may be shaped by grinding dry with diamond wheel, Norton says. Resharpening may be done on the same metal-bonded diamond cup wheels employed for sharpening carbide tools.

The Alundum ceramic tool bits are still in the development stage, Norton cautions. Limited quantities are available to industry for research and machining studies.



SPECIAL HOLDER minimizes stress concentration on ceramic cutting tool.

Titanium Diboride

Rand Development Corp., Cleveland, has solved many of the problems of applying titanium to cutting tools.

The advantages of the new material include very long life when used to machine high-hardness steels, Rand says. Tool life is up to 10 times that of tungsten carbide bits. Also, because titanium diboride has a much lower coefficient of friction than tungsten carbide, Rand believes it would be useful in wire-drawing dies.

However, it appears that the material cannot be used for machining titanium, because the metal reacts with the tool. Also, because of brittleness it is not suggested for machining rough castings or other rough-formed material.

Thompson Products, Wesson Tool Co. and Cincinnati Milling Machine Co. have been testing the new tools.

Rand made its first experimental metal-cutting tools incorporating titanium in 1952 when the company was working on high-temperature metals for rocket and jet engines. Early tools showed extremely good cutting and wearing properties, but they lacked workability, couldn't be silver-soldered to a steel shank and were very brittle. Since 1952, Rand has been trying to improve the material's ductility and reduce its brittleness, which is still something of a problem.

The basic raw materials for the new tools—titanium hydride, boron and some alloying elements—are somewhat less expensive than tungsten and carbon, Rand says. Furthermore, since the titanium diboride has about half the density of carbide, material cost will be about half that of a comparable carbide cutting edge. Handling and forming will not be more expensive than for carbide tools, except for reactions where higher temperatures are needed.

To make the tools, titanium hydride and boron in powder form are blended in a tank and heated to 1,100C, at which point a self-perpetuating reaction sets in, during which titanium diboride is formed. This material is cooled, crushed to 1-micron particle size and mixed with the alloying materials, also in powder form. The resulting compound is specially cleaned and treated to make sintering easier and is then ready for forming. The tools can be either rolled or hot pressed in a die.

Rand has experienced good success in hot pressing the tools in carbon

molds The mold, filled with titanium diboride, is induction heated to the required temperature, hot pressed to shape, then broken away Because of the high heat used (the mold has a melting point of 3,500C), the tools come out with a "forged" quality, needing no further work

New Applications Seen For Ceramic Coatings

One way of dealing with the problems of heat generated by supersonic aircraft and missiles is to make wider use of ceramics, W M Sterry, lead engineer of the ceramic group at Boeing Seattle, proposes

Among the applications Sterry suggests

- Heat protection of large skin areas and certain internal structural members adjacent to powerplants
- Corrosion protection for metals now protected by organic or electroplated coverings which cannot withstand high temperatures
- Marking uses where heat would destroy painted lettering
- Adhesive applications, because ceramic bonding will resist very high temperatures

Currently used organic coverings deteriorate at about 650F, the usual electroplates, such as zinc and cadmium, become inadequate at about 700-800F, Sterry says, and also can cause hydrogen embrittlement in many high strength steels Air passing over a plane's skin at Mach 3 reaches a temperature of 800F At Mach 4, the temperature is 1,500F

Ceramic coatings will probably be some of the low-temperature firing enamels developed recently for sheet steels, Sterry says He suggests further investigation of unconventional application techniques, such as flame-spraying

Sterry predicts that ceramics will see extensive use for protection against gaseous corrosion near powerplants, where temperatures reach the 1,300-1,500F range

The ceramics are also expected to prove useful in protecting titanium alloys above 1,000F, where the metal becomes susceptible to embrittlement through reaction with nitrogen and oxygen Initial work shows that ceramic coatings will considerably prolong the life of a titanium component beyond that of a similar non-coated one

Although development of ceramics for titanium alloys will require considerable work, in Sterry's opinion, the task will be eased because the typical sheet steel enamels can readily be applied to titanium alloys

Coatings for aluminum and magnesium are expected to be good up to about 500F Above that, the strength-weight ratios of the metals become too low

Today's aircraft use hundreds of painted and stenciled markings Porcelain markings in various colors can take over where high temperatures make other methods impractical Sterry says ceramic decals might be applied to parts and then fired with a torch, or flame-spraying through stencils may prove successful

In adhesive applications, ceramics compare favorably with brazing for high-temperature use They require lower processing temperatures and less critical atmospheric control and offer the readily workable properties of molten glass Sterry says those factors may outweigh the disadvantage of a brittle ceramic bond

Supercharged B.E.25 Turboprop on Test Stand

Complete B E.25 supercharged turboprop powerplant, designed to maintain a constant 4,000 hp from sea level to 20,000 ft, is now running on Bristol Aeroplane Co test stand Sixty B E.25s have been ordered by British Overseas Airways Corp for the 300LR, advanced version of the Britannia airliner Design studies for the engine began in 1952

Walkout Won't Affect Lockheed Expansion

Los Angeles—Lockheed Aircraft Corp will continue to expand the research activities of its guided missile division despite the walkout of 15 of its top scientists earlier this month over basic differences in opinion as to how the company should run the division (AW Dec 19, p 16)

Regarding the division's plans, Dr Louis N Ridenour, new director of the Research Laboratories Branch, had this to say

"The division's company-sponsored program of basic research, exclusive of contract research, will be stepped up very appreciably—I might say by several hundred percent—above 1955's program"

Ridenour contemplates no changes in the company's policy of administering the guided missile systems program

Resignations earlier this month resulted from a company announcement on lines of authority on missile projects which the scientists felt placed them in a secondary role

A majority of the departed scientists, according to Dr Montgomery H Johnson have taken formal steps toward setting up their own consulting firm in the Los Angeles area He said the group represents "quite a spectrum of talent which could be used in other than missile work" He mentioned both the electronic and computer fields

External, Jettisonable Gas Load for C-123

Four external, jettisonable fuel tanks carry the entire gas load on Fairchild C-123 assault transports now being delivered to the Eighteenth Air Force. In an assault landing or other emergency, the pilot can release the fuel cells to reduce the danger of fire Two nacelle tanks located aft of the engine firewalls carry 730 gals each, pylon mounted auxiliary tanks placed beneath outboard wing hold 450 gals each In picture above, pilot has just released one of the tanks during a test run

Navy Contracts

Following is a list of unclassified contracts for $25,000 and over, as released by Navy Contracting Offices

AVIATION SUPPLY OFFICE, Philadelphia 11, Pa

Scintilla Div., Bendix Aviation Corp, Sidney N Y coil assys (383/2116-74/53 383/2116-26/54 383/2116-17/55) 1 301 ea $88 456

Vickers Inc, 1400 Oakman Blvd Detroit Mich relief valve assys and reservoir assys (383/2150-985/51 383/2186-676/52 383/2150-103-53) various $111 452

Plastoid Corp Hamburg N J wire (383/26081-10-Ee/1/56) 4 825 000 ft $28 416

Stratos Div Fairchild Engine & Airplane Corp Bayshore L I N Y services & material (383/26066 3x7/56 383/2110-1400/52) various $74 262

American Bosch Div., American Bosch Arma Corp 3664 Main St Springfield Mass magneto assys (384/2116-22/54 383/2116-14/55) 1 162 ea, $275 535

Vickers, Inc 1400 Oakman Blvd, Detroit Mich assemblies and maintenance parts (383/2150-1640/52) various $67 549

Bendix Aviation Corp Hamilton Division Hamilton Ohio services and materials in overhaul fuel controls (383/23003 30/P6/1/56 383/2117-79/51 383/23023-12P6-6/56), various $606 298

Scaffold Equipment Co P O Box 8736 Pittsburgh 21 Pa work stand for P2M 1-2 aircraft (383/26065 583/21/56) 30 ea, $56 843

Goodyear Tire & Rubber Co Inc 1144 East Market St Akron 16 Ohio brake assys (383/2116-129/54) 262 ea. $66 764

McDonnell Aircraft Corp, P O Box 516 St Louis 3 Mo maintenance parts for F2H aircraft (383/2118 1719/51) various $34 536

Regent Jack Mfg Co Inc, 11906 Regentview Ave Downey Calif jacks (383/29065 2183 21/22/56 383/26066-2253-21/22/56 various, $47 406

Malabar Mfg Co., 850 Doolittle Drive San Leandro Calif jacks (383/20065-2183/21/22/56) various $30 417

Airtron Inc 101 E Elizabeth Ave Linden N J waveguides (383/2136 020-E3/3/52) 1 060 ea $31 629

Holley Carburetor Co. 11955 E Nine Mile Rd Van Dyke Mich maintenance parts to support Holley fuel controls (AF WIPR13 600 3 02A 535 (Item 16) Amend S 16 and 26) various $31 068

Minneapolis-Honeywell Regulator Co. 2600 Ridgeway Rd Minneapolis 13 Minn lock units (383/2120 492/52 383/2120-571/51) 299 ea $30 268

Elcon Mfg Co 430 E Manchester Ave Los Angeles 2 Calif disconnect batteries (383/29831-22P5/4/56) 3 848 ea $78 305

Benjamin Franklin Paint & Varnish Co., 4820 Langdon St Philadelphia 24 Pa paint interior (IFB 383-36-56) various $35 067

Airpath Instrument Co Lambert Field St Louis 21 Mo compasses (IFB-383-103-56) 2 659 $55 229

Mob Paint & Varnish Co Inc 47-36 5th St L I C 1 N Y enamel semi gloss (IFB-383-82-56) 80 000 gal $161 101

Atlas Paint & Varnish Co, 32-50 Buffington Ave., Irvington 11 N J enamel semi-gloss (IFB 383-62 56) 84 410 gals, $154 610

Joy Mfg Co 1201 Macklind Ave St Louis 10 Mo. cable assys, (IFB-383-119-56) 650 ea $20 744

Switlik Parachute Co. Inc 1325 E. State St Trenton N J parachute assys (383/29045 29G3/4/56), various $638 412

Trustees of University of Pennsylvania, 3446 Walnut St. Philadelphia 4 Pa services & facilities (62260/2481/50) various $190 000

New York Air Brake Co Watertown, N Y hydraulic pumps for F3H-1N/NM/A/C (383/2150 1077/52 386/2150-404/51), 49 ea $90 078

General Electric Co 1405 Locust St., Philadelphia Pa services necessary to modify amplifier & control (383/2326-152/53 383/2120 508/51) various, $60 692

Reliance Chemical Co, Louisville Ky enamel (155/158077/56) 65 000 gal $194-058

Sperry Gyroscope Co Div of Sperry Rand Corp Great Neck N Y generators (383/29081-209 E 2/7/56) 310 ea $36 537

Chicago Aerial Industries Inc. 1680 Hawthorne Ave Melrose Park Ill view finder assy control system control assy (383/2110 1600/513 383/2110 1005/52) various $194 720

Goodyear Tire & Rubber Co, Inc 1144 E Market St Akron 16 Ohio disks, lining brake & wheel assys (383/2116-158/54 383/2116 24/55 383/2116-1529/52) various, $260 946

Pacific Airmotive Corp, 2940 N Hollywood Way Burbank, Calif regulator assys (383/26611 65x7/1/56) 44 ea, $25, 926

Topp Industries Inc 3255 W 102nd St Los Angeles Calif transmitters for F4D 1 A/C (383/2120-113/53) various $20 482

C K Williams & Co., 640 N 13th St.

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SECTION 49
111 Goundry St., N Tonawanda, N. Y.

Easton Pa. cuprous oxide (158/180007 F/55) 122 000 lb, $83 253

Scintilla Div Bendix Aviation Corp Sherman Ave Sidney N Y assemblies & maintenance parts, (383/2118-27/54 383/2116-127/53) various $198 344 distributor & maintenance parts for P2V-5 A/C (383/2118-8005/55) various $17 239 distributors for various engines (383/29028-89X5/1/55) 118 ea $20,382

Goodyear Tire & Rubber Co Inc 1144 E Market St Akron 16 Ohio assemblies & maintenance parts (383/2110-145/54) various $289 537

AiResearch Mfg Co., 9851-9951 Sepulveda Blvd Los Angeles Calif, thermostat assy & regulator (383/2110-1480/50, 383/2118-83/84, 383/2211d-18/55) various $28 983

McDonnell Aircraft Corp P O Box 516 St Louis 3 Mo cylinder assy (33211-1768/F1) 55 ea $51 012

Turco Products Inc Terminal Annex 2649 Los Angeles 54 Calif cleaning compound (383/28081-330G4/4/56) $68,843

Boonton Radio Corp Boonton N J Univerter (383/29089 29E3/3/58) 73 ea $22 987

Bendix Aviation Corp Hamilton Div Hamilton Ohio servicing of fuel controls (383/23888-31/P8/1/88 383/2117-80/51) various $112 780

Bobe Aircraft Corp., Foot of H St, Chula Vista Calif joint assys for Al A/C (383/2110-1150/52) various, $141 518

Marquette Metal Products Co 2145 Galewood Dr., Cleveland Ohio maintenance for various A/C (383/2120-1278X7/3/81), various, $38 837

Norden-Ketay Corp Precision Components Div 858 Broadway New York 12 N Y major assy., (383/2110-1438/82) 51 ea $29 138

Red Bank Div, Bendix Aviation Corp Eatontown N J generator (383/29031-7X2/1/56) 99 ea $54 964

Scintilla Div., Bendix Aviation Corp Sherman Avenue Sidney N Y maintenance parts (383/28023-3X8/2/58) various, $89 113

Metalcraft Mfg & Sales Corp, 111 E 17th St. Kansas City 8 Mo test bench harnesses & parts (383/29283-33E2/8/58) various $32 389

Aeroquip Corp 333 South East Ave., Jackson Mich couplings (IFB 383-284-88) various $48 483

Chicago Aerial Industries Inc 1983 Hawthorne Ave Melrose Park Ill view finder assy control system control assy (383/2110-1300/51 383/2110-1003/52) various $194 728

BUREAU OF AERONAUTICS Navy Department Washington D C

Reeves Instrument Corp., 215 E 91st St New York 28 N Y solve simulation problems as assigned or approved by the Bureau of Aeronautics maintain cycling laboratory equipment modify and improve existing equipment reports NOas 88 571 c (EL 42 1307 56) $302 622

Sperry Corp Sperry Gyroscope Co Div Great Neck L I N Y flux valves NOas 58-70e-f (PD-42-2939-55) 889 $185 428

D Ballauf Mfg Co. Inc, 213-21 H St. N W Washington, D C materials and services for testing eight government owned variable speed drive units NOas 56 637 c (PP-32 783 55) $28 441

Sciaky Brothers Inc, 4915 W 67th St Chicago 38 Ill furnish materials and services necessary to develop an improved method of evaluating the quality of spot welds in titanium alloys reports NOas 56-954-c (AE-41 555 85) $30 249

New York University College of Engineering, University Heights New York 53 N Y conduct an investigation for a means of minimization of the influence of residual hydrogen on brittleness in alpha-beta titanium alloys reports NOas 56 955 d (AE 41 858 83) $27 852

Minneapolis-Honeywell Regulator Co, 4925 Wisconsin Ave N W Washington D C services of three factory trained field service technicians to instruct Naval and Marine Corps personnel in the field in the operation maintenance and servicing of Aero 18A and B labs NOas 58 874-a, (MA-32 4430-78) $40 834

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CAB Report on Pan American B377 Crash off Oregon

Stratocruiser Ditched When Engine Fails

A Pan American World Airways Boeing 377, N 1032V, was ditched in the Pacific Ocean, approximately 35 miles off the Oregon Coast, at 1112,[1] March 26, 1955, after No 3 engine and propeller tore loose and fell free, followed by control difficulties

All 23 occupants were evacuated but four fatalities and one serious injury occurred The aircraft sank after an estimated 20 minutes, in water about one mile deep

Trip 845/26, a scheduled flight from Seattle Tacoma, Washington, to Sydney, Australia, departed Seattle-Tacoma Airport at 0815 for Portland, Oregon the first intermediate stop There were 13 passengers and a crew of 8 consisting of Captain H S Joslyn, First Officer A C Kendrick Navigator M F Kerwick, Flight Engineer D R Fowler, Assistant Flight Engineer S Bachman, Purser Natalie R Parker, Stewardess Elizabeth M Thompson, and Steward J D Peppin

The flight to Portland was normal in all respects with arrival at 0910 There the aircraft was serviced and two additional passengers boarded Only routine inspections and service were accomplished

The flight left the ramp at 1010 and took off for Honolulu, Territory of Hawaii, at 1021 on an IFR clearance Weather conditions at time of takeoff were VFR There were 15 passengers and the same crew of 8 Takeoff gross weight was 139,494 pounds (maximum allowable was 145,800 pounds) and the center of gravity was located within limits

The flight plan was via Newberg and Newport, Oregon and thence to Honolulu to cruise at 10,000 feet Estimated flight time was 11 hours and 3 minutes The flight reported over Newberg at 1031 at 7,000 feet climbing, reached 10,000 feet at approximately 1039, and reported over Newport at 1048 at cruising altitude The aircraft was then headed to make good the initial track of 221 degrees true

Engine and Prop Tear Loose

Forty-two minutes after takeoff, severe vibration occurred while cruising at 10 000 feet under VFR conditions This lasted for five to eight seconds following which No 3 engine and propeller tore free and fell from the aircraft

The captain immediately disconnected the autopilot Severe buffeting ensued, the nose went down and the aircraft swung to the right sharply At this point the emergency "Mayday" signal was broadcast on both VHF and HF Direct return to Portland was authorized by Seattle Air Route Traffic Control

The captain, in the left seat, tried to get the airplane under control Airspeed was about 220 knots and going higher so he closed the throttles to keep the airspeed down He still could not get the nose up, it felt to him as though the elevators were still on automatic pilot He tried the elevator trim tab and could not turn it

After rapid loss of altitude to about 5,000 feet, the captain directed the first officer to assist him with the controls Their combined efforts finally brought the nose up very rapidly but the aircraft then went into a steep climb It turned sharply to the right about 180 degrees and, according to the captain appeared to be on "the verge of a spin"

Level attitude was regained by pushing the yoke forward, and by use of the rudder and aileron trim the turn was stopped At an airspeed of 150 knots, flaps extended 25 degrees, buffeting decreased immediately however, the aircraft continued to descend rapidly

Attempts to get rated power were futile and a message was broadcast that ditching was imminent This message was sent at approximately 1106

Preparation for Ditching

The aircraft was then at an altitude of 500-1000 feet Ditching was imminent Cabin attendants realizing the emergency, assumed their respective stations for ditching All passengers had been seated in the upper deck of the cabin with seat belts fastened and life jackets donned[2]

The aircraft touched down under near ideal sea conditions with little swell Contact with the water was severe and the impact dislodged life rafts from their storage bins and some seats were torn loose The aft portion of the fuselage and empennage broke off at impact

Evacuation was orderly and the three rafts, although dislodged from their stowage receptacles, were launched without undue delay The lanyards of all three life rafts were temporarily held at the cabin door by crew members However, when one of the rafts was endangered by sharp metal of the broken fuselage its lanyard was released Another was released by a crew member who then swam to that raft to right it The lanyard of the third raft was released for unknown reasons Consequently the rafts were carried away by the light surface wind

Passengers and crew left by both the main cabin door and escape hatches on both sides of the fuselage over each wing Some crew members and passengers were able to swim to and board the rafts Three of the four fatalities, including the copilot and first engineer, were unable to do so and were lost Members of the crew and passengers tried in vain to paddle to these persons One other passenger later died in a raft from exposure and shock

The purser, a woman, although suffering from shock swam and towed the only seriously injured passenger to the nearest raft, some 200 feet distant[4]

The time of ditching was determined as 1112 and the position at lat 43°48'15" N, long 125°12'40" W., approximately 35 miles off the Oregon coast The U S S Bayfield, en route to Seattle, changed course toward the site and by aid of search aircraft reached the life rafts some two hours later

INVESTIGATION

Investigation disclosed that the dispatching of this flight was in full conformity with all government and company requirements Up to the point of no return the alternate was Portland, Oregon

Water approximately one mile deep precluded recovery of the wreckage Small light portions of no significance to the investigation were subsequently washed ashore on the coast

Because the failure originated in the No 3 engine or propeller, followed very quickly by that power package wrenching free, investigation was aimed at ascertaining the nature of the malfunction and reason for the failure

The aircraft was powered with four Pratt and Whitney R4360 B6 engines and equipped with Hamilton Standard model 24260 propellers and model E2J17Z3 8W nickel-plated blades

Possible Causes

Loss of the engine and propeller could have been caused by
(1) Failure of the engine mount
(2) Sudden stoppage or seizure of the engine
(3) An unbalanced propeller caused by failure of a blade

Since the engine and propeller could not be recovered there was no opportunity to examine them

The first possibility—failure of the engine mount—seems unlikely as testimony indicates that when the engine left it took its mount with it leaving nothing forward of the firewall except small parts such as wires and lines

Regarding the second possibility—that of sudden engine stoppage or seizure—investi-

[1]All times referred to herein are Pacific Standard and are based on the 24 hour clock.

[2]Passengers were given a life jacket demonstration by the steward at Portland prior to departure and each handed a folder, "Just In Case (of a ditching)

[4]Vice Chairman Adams of the Civil Aeronautics Board serving as a panel member at the Board's accident hearing publicly praised Miss Parker the purser in these words "I think that it was most inspirational and on behalf of the Board I would like to personally commend you for your work I think that all of us feel inspired that a fellow citizen or just a fellow human being can rise to such an occasion in the manner in which you did It is most commendable, Miss Parker"

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gation disclosed that there have been no known cases in which an engine has torn free from this model aircraft as a result of sudden stoppage.

The third possibility—an unbalanced propeller—must therefore be the cause of the failure. Other blade failures of this propeller-engine combination have produced similar results.

There have been five previous instances of total powerplant separation from like aircraft and one of partial separation. Of these six, two were definitely caused by propeller blade failure, and the remaining four (where engines were not recovered) undoubtedly resulted from the same cause.

Previous Propeller Failures

During the service life of this propeller, the manufacturer developed modifications and more restrictive inspection and maintenance procedures, all of which were aimed at improving the integrity of the blade. The most recent modification was to nickel-plate the blade surface to minimize service-incurred nicks and gouges. Blades on the PAWA fleet of B-377 aircraft were nickel plated and maintained in accordance with the manufacturer's latest service instructions.

The investigation of this accident included a study of the results of special inspections that were initiated subsequent to the accident to determine the integrity of service blades. These inspections included X-ray, Magnaflux and detailed visual examinations of blades externally in areas normally not readily accessible, i.e., under rubber fairings. Hitherto this area had not been suspect.

This comprehensive program disclosed nicks and gouges beneath the garter caused during a manufacturing operation following plating. Furthermore, as the program proceeded, a cracked blade, not nickel plated, was found on the aircraft of another carrier. Study of this crack revealed that it resulted from fatigue and that it originated at a corroded area under the rubber fairing.

Until March 26, the date of the accident, no cracks had been reported as being found on nickel plated blades. However, the intensive inspection program revealed three cracked model 2J17 blades that were associated with corrosion and one blade failed from the same cause while undergoing fatigue testing at the factory. The X-ray program revealed one new blade at PAWA cracked beneath the rubber boot. This crack had occurred during blade manufacture but had remained undetected.

Corrosion which is known often to serve as foci for fatigue failure was found on 13.5% of the PAWA Pacific Alaska Division blades.

The routine in-transit service maintenance on Trip 845 at Portland consisted of a visual inspection of propellers, landing gear wheels, tires, control surfaces, engine cowling, etc. The inspection was made by two mechanics, one examining the cambered side of each blade, the other the flat side. No imperfections were found.

Propeller Speed Control

The propeller speeds of the aircraft were electrically controllable. Control could be individual or simultaneous.

The electrical system employs fuses for the four individual engine circuits and master circuit breakers, both of which are common to all four circuits. One master circuit breaker is in the automatic synchronization circuit and the second one is in the circuit for manually selecting engine r.p.m.

In this instance the bearing area of No. 3 engine obviously created a short in that portion of the system serving No. 3 engine. A subsequent attempt by the flight engineer to increase r.p.m. by use of all switches simultaneously (for rated power) resulted in opening of the master circuit breaker so that the r.p.m. of none of the remaining three engines could be changed.

Testimony indicates that the engineer closed the circuit breaker and again attempted unsuccessfully to get simultaneous increase of r.p.m. By this time the aircraft was nearly to the water. The captain stated that the r.p.m. never increased.

Unforeseen Contingency

Flight Engineer Fowler attended two classes in 1955 on propeller control circuitry. It has been established, however, that the specific contingency that occurred in this accident was never taught in any of these classes nor had the company issued any specific instructions in regard thereto. Nor could this particular type of situation be approximated precisely in the Delmel flight engineer simulator course.

Flight Engineer Fowler had been employed by PAWA since December 1938. After serving in various capacities he was classed as a flight engineer in April 1942. Mr. Fowler had served as flight engineer in B-377 aircraft some 4,530 hours.

Assistant Flight Engineer Bachman, who was occupying the jump seat at the start of the emergency, for a while stood behind the engineer and observed that the aircraft's behavior was similar to that previously described, i.e., heavy aerodynamic buffeting and difficulty of the captain and copilot in controlling the aircraft. He recalled that the three engines were running smoothly.

At this point Bachman suggested to Engineer Fowler that the pilots would have less difficulty in raising the right wing if he would give them more power from No. 4 engine. Fowler replied he was unable to get any r.p.m. change. Bachman then reached over and advanced No. 4 throttle several inches. At this time he observed the altimeter reading to be 600 feet.

Bachman then watched him actuate the propeller toggle switches, also with no effect and saw him reset the propeller control circuit breakers. Bachman then went to the passenger cabin for ditching.

Three-Engine Performance

The manufacturer of this aircraft had prepared performance curves for three engine flight of the Boeing 377. These performance curves were based upon actual flight tests and wind tunnel tests of the aircraft to verify flight conditions that existed following the loss of No. 4 engine from a sister ship.[1]

The curves depict the flyability of this model aircraft with No. 3 torn free, as happened in the subject case. They show assuming landing gear up, flaps extended 25 degrees, an airspeed of 130 knots, which is the airspeed for minimum power requirements that the aircraft grossing 131,000 pounds would be flyable at takeoff power, 2,700 r.p.m. (131,000 pounds is the computed gross weight after separation of the No. 3 power package).

These deductions by the manufacturer are premised upon there being no structural deformation of the aircraft (as from impact in part or parts at time of failure). If such existed additional power requirements of unknown degree, would have been imposed.

Testimony also indicates that the subject aircraft would require a weight reduction of 11,000 pounds to reach 120,000 pounds, the weight necessary to sustain level flight in the vicinity of sea level with the power obtainable at 2,040 r.p.m.

Captain Joslyn testified that prior to extending flaps about one minute before ditching there was not sufficient time to consider dumping fuel.

Life-Raft Launching

The three 20-man life rafts were loaded with 13, 5 and 2 occupants. One crew member and one passenger were in one raft. In the second were the second engineer and four passengers, and the third carried the captain, second officer, purser, stewardess, and passengers to make a total load of 13. The nearest raft to any of the three persons who were not rescued was estimated to be 100 feet or more. The heaving lines in all three rafts were 25 feet long.

Two of the life rafts were of one make, the third of another. The first two had less distinct and more limited stenciled instructions for use than had the third. Crew members were acquainted with these instructions but passengers were not and consequently were handicapped in their efforts to assist in rescue efforts.

The first two rafts had small nylon lifelines, extending completely around the outside circumference to assist in boarding. Passengers stated this cord was not visible after being coated with oil on the water. The third raft had a fabric braided strap which was more readily seen.

These rafts had inflatable center chambers to provide extra buoyance, rigidity, and to prevent occupants from sliding toward the center. The center chambers had to be inflated after launching with a hand pump carried in the raft.

Until this was done occupants slid toward the center because it was depressed and the surface was oil covered. Moreover, the action of occupants slipping toward the center raised the rim which made boarding even more difficult and prevented those in the raft from helping persons in the water.

The equipment bags containing paddles, heaving lines, etc., are outside the raft after inflation and it is necessary to reach the edge of the raft to recover them.

Evacuation Was Orderly

Both passengers and crew members testified that the evacuation was orderly and

[1] See Civil Aeronautics Board Accident Investigation Report PAWA Between Honolulu and Wake Island, December 6, 1953.

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This generator can be furnished with either square or round mounting flange and is suitable for use on Continental R9A, P & W 985, P & W 1340, P & W 1830 and Wright GR 1820 engines.

For military applications, the generator conforms to AF Drawing 52B 6588 and will deliver full output at 35,000 feet altitude and 75% rated power at 50,000 feet.

CHARACTERISTICS

Speed	2500-4500 rpm
Min. Speed for Regulation	2500 rpm
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Power	3000 watts
Min. Air Blast Pressure	6 in. water
Weight	39.5 lbs.

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Canadian Distributors: Aviation Electric Ltd., P.O. Box 6102, Montreal, P.Q.
Export Sales: Bendix International Division, 205 E. 42nd St., New York 17, N. Y.

conducted in an expeditious manner, with the exception of the difficulties heretofore mentioned.

Pan American had an established Aircraft Emergency Equipment Training Course for crew members. Prior to taking this Emergency Equipment training all flight personnel must have completed a course of aircraft familiarization including a complete knowledge of the aircraft's doors, emergency exits, etc.

The flight was under surveillance of ground radar. A plot of its observed positions confirms the crew's testimony as to the aircraft's maneuvers while descending. It shows, specifically, that starting from cruising altitude of 10,000 feet on a southwesterly course, the aircraft made a full 360 degree turn to its right and then turned rather sharply about 180 degrees, also to its right, and was then lost to the radar as it went below 500 feet (just prior to ditching).

The direction of ditching was about opposite that of the initial cruising flight; about a full turn and a half to the right was made between the start of the trouble and the ditching, the total elapsed time was recorded as nine minutes.

ANALYSIS

In the consideration of this accident and its results there are a number of factors, which are dismissed as follows:

(a) Initial failure.
(b) Control difficulty and its probable reason.
(c) Inability to increase r. p. m. of other three engines.
(d) Non-dumping of fuel.
(e) Ditching, survival and rescue.
(f) Corrective action.

Initial Failure

The vibration which occurred immediately before No. 3 power package wrenched free followed a familiar pattern of known propeller blade failures.

Despite the power package not being recoverable, the Board has no reason to doubt that the trouble was due to blade failure. This belief is based on the known history and subsequent examination of model 2J17 blades. This examination disclosed hitherto unsuspected corrosion beneath rubber fairing on the shanks of 13.5%, or 43, of the fleet's 318 blades. One of these 43 was cracked.

Examination of blades in other service revealed one cracked on a military aircraft and one cracked on another air carrier aircraft.

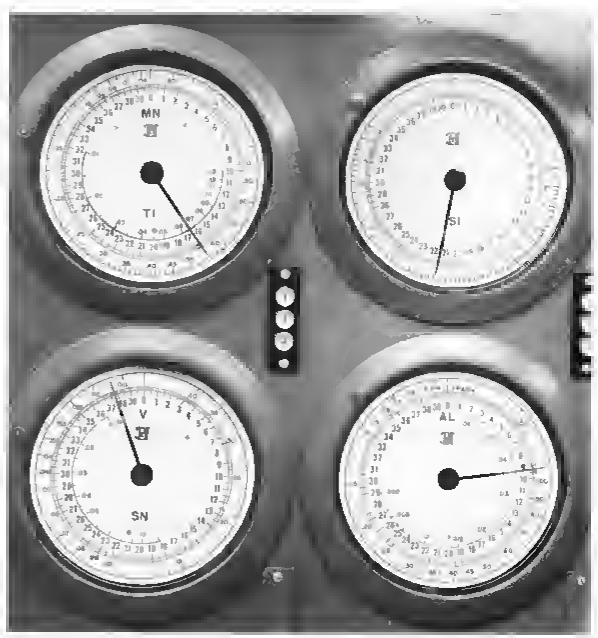
This base blade is, as demonstrated by its service history, prone to crack at surface irregularities. This fact dictates meticulous inspection during manufacture and while in service. Corrective action is now under way, as will be shown later in this report.

Control Difficulty

The Board is unable to determine the reason for the initial control difficulty.

It may have been aggravated by an undeterminable irregularity of air flow over the empennage caused by the large, flat plate area of No. 3 firewall.

It may also have been due to some de-



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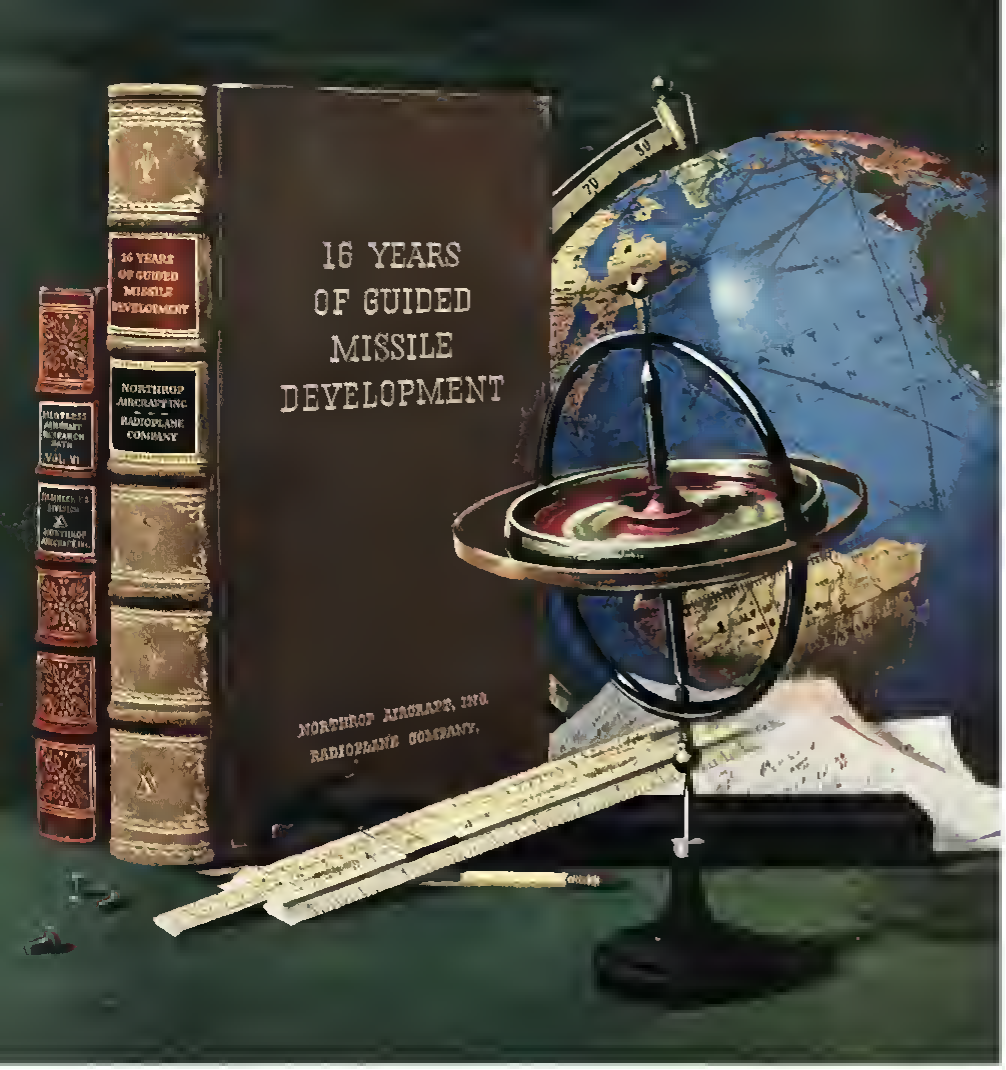

BALANCE — Foremost of Northrop achievements is an efficient organization well balanced between the poles of advanced research and economical production. Northrop scientists in physics, astronomy, metallurgy, electronics, aerodynamics, optics and many other fields are doing their work *years* in advance of the need. From this long-range thinking and planning within the Northrop complex have come the Radioplane Company's family of pilotless drones and missiles, first and foremost in their field; the Scorpion F-89 interceptors, present defenders of our heartland approaches; and Snark SM-62s, deadly intercontinental A-bomb carriers. As streamlined as its products, the well-balanced Northrop organization is at work on even greater weapons to strengthen this nation's defense ... and is more ready than ever to develop and produce them efficiently and on schedule.

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formation of the airframe, particularly of the empennage, caused by some violently slung object or objects from the No. 3 power package. This possibility is strengthened by the difficulty the pilot had in moving the yoke which necessitated his calling on the first officer for assistance. However, no impact at the time of or immediately after the failure was sensed by any occupant.

Whatever the cause, electric control was regained after rapid loss of considerable altitude and the aircraft was ditched under control.

Inability to Increase RPM

The flight engineer on duty at the time of the accident did not survive. Consequently, the nature of the difficulty that he experienced in attempting to increase engine speeds can only be learned from other testimony. This testimony is largely that of the assistant flight engineer and, to a lesser extent, of the captain.

There was no evidence that there was mechanical or electrical impairment of the control system of Nos. 1, 2, and 4 propellers.

There had been no trouble of any sort prior to the emergency.

In view of the known characteristics of the protective devices in the propeller control circuitry, it can be concluded that the inclusion of the No. 3 toggle switch in the simultaneous actuation of the toggle switches was the responsible factor in not getting increased r.p.m.

Effective as of approximately April 20, 1955, the 10 amp. magnetic circuit breakers were replaced by slower acting 5 amp. thermal type circuit breakers in both master circuits and the 5 amp. fuses in the individual circuits were replaced by 2 amp. fuses.

This change allows the fuse associated with the malfunctioning circuit to blow and thus leave the remaining circuits unaffected. This modification was detailed in Hamilton Standard Service Bulletin No. 283 entitled "Synchronizer Toggle Switch Circuit Protection," dated December 21, 1953.

Compliance with this bulletin was not mandatory by the CAA although the importance of its text was effectively demonstrated by the circumstances of this accident and it was made mandatory by the CAA, April 21, 1955.

It may be pointed out that this modification was also applicable to the carrier's fleet of Douglas DC-6s and had been made on them, it was the company's intent to make similar modifications on its fleet of Boeing 377s as soon as practicable.

Non-Dumping of Fuel

As previously stated, engineering opinion is that the subject aircraft would have been flyable with No. 3 engine gone at 2,040 r.p.m. had its weight been reduced to a gross of 120,000 pounds. This would have required a weight reduction of approximately 11,000 pounds.

The maximum rate of fuel flow during dumping at 165 knots indicated is approximately 2,160 pounds per minute. Thus it would have taken slightly more than five minutes to lose 11,000 pounds, from initial difficulty to ditching was approximately nine minutes.

It appears that if fuel dumping could have been started immediately after the failure the aircraft could have been lightened rapidly enough to have been more flyable on the three good engines. However, the captain's time was occupied in attempting to control the aircraft and the problem of the inability to increase r.p.m. Furthermore, the captain stated that there was not sufficient time to even consider dumping fuel.

Ditching

The aircraft was ditched in daylight under near ideal sea conditions. This was the first ditching of a civil B-377 aircraft, consequently, there was no direct knowledge of its ditching characteristics. The aircraft remained afloat for approximately 20 minutes.

Under these favorable circumstances and with comparatively few passengers (15) it might be anticipated that little difficulty would be experienced in getting everyone aboard life rafts. Such was not the case.

For various reasons the rafts were cast adrift after being launched, as explained. This necessitated most occupants getting into the water and swimming to the rafts which were being drifted by the light wind. Two of the crew members and one passenger were unable to reach them and perished.

The conduct of individual passengers and individual crew members was high. Purser Natalie Parker displayed courage and devotion to duty which was exemplary. However, the fact that the rafts had to be cast adrift undoubtedly made it extremely difficult to rescue all persons and was a contributing factor to the loss of life.

Search and Rescue facilities were put into effect speedily and efficiently.

Corrective Action

The occurrence and investigation of this accident resulted in a number of corrective measures being initiated among which were:

(1) Life rafts were stowed more securely.

(2) Additional inspections of the propeller blades were required and the period between previously required inspections were in some instances shortened.

(3) The schedule of installation of propeller blade imbalance detectors which had previously been developed to warn the crew of an impending blade failure was expedited and their use made mandatory by the CAA as of July 30, 1955.

(4) The manufacturer resumed development of a solid aluminum propeller blade for use on B-377 aircraft. The CAB recommended to the CAA that all Hamilton Standard 2J17 hollow steel blades be removed from service on the B-377 aircraft at the earliest possible date consistent with the manufacturer's ability to supply satisfactory blades.

(5) The Administrator, by letter dated

X-Ray Propeller Inspection

Pan American World Airways uses a portable X-ray machine to inspect propellers (Boeing Stratocruiser unit shown in photo), radiators, manifold harnesses, cylinders, landing gear and fuselage structures. Since PAA started its prop inspection program, more than 8,400 X-ray shots have been made. Garter area of each blade is inspected every 1,400 hr. and the blades themselves every 2,800 hr. Delta Airlines, a pioneer airline user of X-ray equipment (AW Sept. 20, 1954, p. 71), is now employing the technique on DC-7 wing stringers. Two men are needed to inspect the structure from wing station 421 left to 421 right. Delta estimates it saves 1,000 man-hours a year by not having to open wing inspection doors. The Andrex unit operates off any 110-v. or 220-v. supply without special transformers. It is available from Holger Andreasen, Inc., San Francisco, Calif.

OPERATIONS ENGINEERS

The Operations Engineering organization in the Military Relations Department at the Fairchild Aircraft Division offers opportunities for graduate engineers capable of performing aircraft utilization analyses.

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The opportunities and salaries associated with the new positions are in keeping with the responsibilities of this work. Employee benefits in the form of group insurance, individual and family coverage for hospitalization, retirement plan, sick leave, etc., are also provided.

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ALL REPLIES WILL BE HELD IN STRICT CONFIDENCE

June 28, 1955, advised operators of the B-377 aircraft as follows: As a result of this investigation, and of the investigations conducted following six other accidents or serious incidents, we have concluded that, in the interest of safety, the Hamilton Standard Model 24260 propellers having 2)17 series hollow steel blades presently used on Boeing B-377 aircraft should be removed from service and replaced with propellers having solid metal blades. This shall be done at the earliest possible date consistent with the ability of the propeller manufacturer to supply satisfactory blades.

(6) Special inspections as determined to be required were made mandatory by the Administrator, first by telegraphic alerts and subsequently by Airworthiness Directives dated April 11, 1955, June 6, 1955, and October 10, 1955.

Development of solid aluminum alloy blades suitable for use on the Boeing B-377 has been a high priority project with the manufacturer, Hamilton Standard. As of October 20, 1955, four slightly differing experimental propellers have been built.

Flight testing is required, and is scheduled for the immediate future, to determine the best of the four.

FINDINGS

On the basis of all available evidence the Board finds that:

1. The company, the aircraft and the crew were properly certificated.
2. The flight was properly dispatched.
3. The aircraft was properly loaded with respect to gross weight and center of gravity limits.
4. Weather was not a factor in this accident.
5. The aircraft and all its components functioned normally until a blade of No. 3 propeller failed.
6. The resulting unbalance wrenched free No. 3 power package.
7. Control difficulty resulted in rapid loss of altitude to low altitude.
8. Fuel was not dumped.
9. R. p. m. of the remaining three engines was not increased due to lack of specific training of the crew.
10. This aircraft had not been modified in accordance with Service Bulletin No. 283, however, this information was available to the company.
11. The aircraft was ditched under control approximately 35 miles off the Oregon coast.
12. There were no fatalities as a direct result of the ditching.
13. The three life rafts were launched without undue delay but were permitted to drift free.
14. The aircraft floated for an estimated 20 minutes.
15. Four persons succumbed as a result of shock, exposure and/or drowning.
16. Search and Rescue facilities were notified promptly and responded quickly and effectively.

PROBABLE CAUSE

The Board determines that the probable cause of this accident was loss of control and inability to maintain altitude following failure of the No. 3 propeller which resulted in wrenching free No. 3 power package.

By the Civil Aeronautics Board:
Ross Rizley
Joseph P. Adams
Josh Lee
Harmar D. Denny

(Chan Gurney, Member, did not participate in the adoption of this report.)

SUPPLEMENTAL DATA

The Civil Aeronautics Board was notified of the accident at 1145 P. S. T., March 26, 1955. An investigation was immediately initiated in accordance with the provisions of Section 702 (a) (2) of the Civil Aeronautics Act of 1938, as amended. A public hearing was ordered and held at Seattle, Washington, April 19, 20, and 21, 1955.

Air Carrier

Pan American World Airways, Inc., is a New York corporation with its main offices in New York, New York. Headquarters for the Pacific-Alaska Division are at San Francisco International Airport.

The corporation operates as an air carrier under a certificate of public convenience and necessity issued by the Civil Aeronautics Board, and an air carrier operating certificate issued by the Civil Aeronautics Administration. These certificates authorize the carrier to engage in air transportation between various points in the United States and foreign countries, including the route involved in this instance.

Flight Personnel

Captain H. S. Joslyn, age 49, was employed by Pan American World Airways April 25, 1940. He held a valid airline transport pilot certificate with a rating for the subject aircraft. Captain Joslyn had a total of 17,872:12 flying hours, of which 1,588:77 were in Boeing B-377s, and 1,725 hours of instrument flying time. Captain Joslyn passed a CAA physical examination on January 21, 1955.

First Officer Angus Gustavus Kendrick, age 34, was employed by Pan American World Airways January 2, 1943. He held a valid airline transport pilot certificate with a rating for multi-engine land aircraft. Mr. Kendrick had a total of 10,125:22 flying hours of which 1,293:42 were in Boeing 377s. His last CAA physical examination was passed on October 30, 1954.

Flight Engineer Donald Read Fowler, age 41, was employed by the company December 28, 1938. He held a valid flight engineer certificate and an A. & E. mechanic certificate and had accumulated 4,530 hours in B-377 aircraft. He received his last CAA physical examination on October 29, 1954, and latest emergency equipment recheck on November 2, 1954.

Assistant Flight Engineer Stuart Bach man, age 29, was employed by the company May 18, 1952. He held a valid flight engineer certificate and had accumulated 300 hours in B-377 aircraft. He received his last CAA physical examination on October 19, 1954, and latest emergency equipment recheck on February 28, 1955.

The Aircraft

N 1032V, a Boeing 377, serial number 15932, was owned and operated by Pan

(Advertisement)

Valve Talk

for WM. R. WHITTAKER CO., Ltd.

by Marvin Milas,
Senior Member, Aviation Writers Assn.

There are two cold wars going on in Alaska.

One a war with cold itself.

The other a constant readiness to chop down any Russian invaders who might strike eastward from Siberian air bases just 100 jet minutes away or south over the pole and the rugged Brooks range.

Neither war can be neglected for a minute.

The approaches to the frigid northern frontier must be scanned constantly by overlapping radar sweeps covering both high and low levels if the big bomber-staging airfields in the territory are to be protected by Northrop F-89D Scorpions on five-minute alert.

Sub-zero temperatures must be battled winter-long to assure intercept efficiency in a theater where seconds count. The bitter cold of ice and snow spreads its beautiful-but-deadly menace continually beneath air crews who may have to bail out or make an emergency landing any time.

The words "Arctic survival" meant little or nothing to me until I flew into the far north with Northrop Test Pilot Bob Love, seven-Mig Korea ace, on a Scorpion delivery flight out of Palmdale, California.

But I soon found that in winter Alaska you always plan two ways — to fly and to stay alive if you're dumped into the snow somewhere in the lonely desolate wastes.

No man flies a jet without a survival kit snapped to his parachute harness a kit that contains everything from a break-down over-and-under shotgun rifle to a sleeping bag, snow saw, emergency rations and signaling gear.

No man flies a jet without a long hunting knife, a flashlight, extra waterproof match containers, extra socks and gloves and candy bars. No man rides aloft unless he wears clothing that will keep him alive in temperatures 40 to 50 degrees below zero, fur-lined parkas, fleece-lined trousers, layer after layer of loose, heavy woolens.

You can never forget that what you don't have with you when you go, you won't have with you when you land. So you figure out ways, for instance, to lash your boots to your ankles with parachute cord so the opening shock of the canopy won't drop you into the snow barefooted!

Our Scorpions were delivered to the 433rd Fighter Interceptor Squadron at Ladd AFB, Fairbanks, a go-get-'em outfit commanded by Maj. John L. (Jake) Moutier Jr., who feels his "Satan's Angels" are the hottest gang on the base.

With two other Scorpion squadrons of the 11th Air Division, the 449th and the 18th, the air crews of the 433rd stand alert duty for two months out of every three, with a 24 hour stint in the "hot room" every sixth day.

When the bell rings they go — and fast — sliding down regular firemen's poles, racing to their birds in the nearby bays, starting engines while the crewmen buckle them in and blasting out to the runway to thunder off in the dirtiest weather, their afterburners spitting long jets of flame in their wake.

When they have a target they never know whether it will be friendly or Russian so they push each run with the all-out aggressiveness of a combat attack. 104 folding-fin rockets ready for triggering, until they make the identification — which so far has been "friendly."

The Scorpion crews are the spearhead of the defensive javelin, flying "top cover" for North America, aided by a vast complex of remote radar stations, combat control centers and involved supply lines. They fly to protect the airfields from which long-range strategic jet bombers could launch retaliatory atomic blows against almost any point in Russia . . . or from which Russia could mount raids on the United States.

You can't help but admire the guts of these men who fight the cold continually. Stabbing, scalpel cold, men who know that the Mig 15s and 17s and the Red twin-jet IL-28 bombers that can be seen on the scopes as they cruise on their side of the "fence" might turn into rocket targets any minute.

With their ground crews, their mechanics, armorers, radar technicians, etc., the pilots and radar observers in the blood-tipped Scorpions are all routine heroes, or rather everyday heroes by routine.

Sheer Poetry

We salute the "poets" of today.

Frequently they make front page news. They also command attention in industrial publications. Industry-wide they contribute the warm glow of inspiration. And industry, in bringing their heavenly ideas down to earth, stands alongside them to share the spotlight.

Though these modern poets do not write in verse, they appeal to our imagination. To us, their communications are immortal. For theirs is the sheer poetry of wondrous feats of accomplishment. They themselves are the engineers and scientists who are the mainspring of our age. We extol them, one and all, and urge them never to cease in their quest for awe-inspiring achievement.

At Sikorsky we have poets like these. We need more. Are you one? If so, please write to Mr. Richard Auten, Personnel Department.

SIKORSKY AIRCRAFT

ONE OF THE DIVISIONS OF UNITED AIRCRAFT CORPORATION

BRIDGEPORT 1, CONN

American World Airways and was currently certificated by the Civil Aeronautics Administration. The aircraft was manufactured May 18, 1949, and had accumulated approximately 13,655 hours. It was equipped with four Pratt & Whitney R-4360-B6 engines and four Hamilton Standard model 24260 propellers with model E2J17Z3-8W blades.

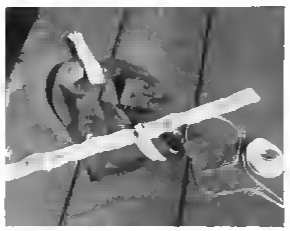
The airframe and four engines and propellers had been maintained in full compliance with prescribed methods and within all time limitations.

New Life Vest for Ditching Survivors

A life-line-equipped life jacket which can be thrown 50 ft. to swimming survivors of a ditched aircraft has been developed and successfully tested by Pacific Northern Airlines, Inc.

Tests with the Navy and Coast Guard showed that a stewardess standing in an unstable, rubber boat could throw the vest about 50 ft. It is best to throw the ring inflated in all but a very strong wind. Navy personnel said the collar is easy to grab hold of and get into while in the water.

The ring is made up of one of the two air chambers of a standard "Mae



West" life preserver. Some 50 ft. of ¼-in. nylon cord is attached to the CO_2 inflation cartridge trigger which allows the vest to be inflated by giving the cord a sharp tug. Ring and cord can be folded into a package measuring 6 in. long, 3 in. in diameter and weighing 15 oz. Canvas webbing loops are provided—two for the arms and a third to hoist the survivor out of the water. Total cost is about $2.00.

Need for throwable, retrievable life vests was pointed up by a recent Stratocruiser ditching off Oregon (See p. 45). Survivors in life rafts were unable to help others struggling in the water because they had nothing to throw to them and the wind was drifting the rafts away faster than an average person could swim.

PNA says that it will furnish free drawings and specifications of its throwable life ring to anyone who is interested. Address Seattle-Tacoma Airport, Seattle 88, Washington. Attention Frank Hansen, chief pilot.

WHO'S WHERE

(Continued from page 15)

R. L. Coffey, manager of military requirements department, Allison Division, General Motors Corp.

Beverly W. Duncan, in charge of research and development, Micro Precision Casting Co., Whitehall, Mich.

Richard T. Williamson, military service representative, Cee-Bee Chemical Co., Inc., Downey, Calif., formerly Deputy Chief, Airlines & Maintenance Branch, Procurement Division, Headquarters, Air Materiel Command.

Michael Gladstone, sales manager, Alloy Precision Castings Co., Cleveland, Ohio. He was formerly president of Centrifi-Cast Co., N. Y. C.

John T. Castles, manager, Elastomer Market Development Unit, Silicone Products Department, General Electric Co., Waterford, N. Y. **Ernest A. DeMetre**, power tube application engineer, General Electric's Tube Department, Schenectady, N. Y. **J. Deryl Case III**, product planning and market research section, Carboloy Department, Detroit, Mich.

Paul L. Harrison, director of sales and marketing, Teleflex, Inc., North Wales, Pa. **Robert A. Gilbert**, in charge of market and sales research and **H. W. Miller**, in charge of advertising and sales promotion.

Capt. J. R. Steer, British Overseas Airways Corp. sales manager for Northeast Asia, replacing **L. F. Wood**, transferred to Karachi.

Douglas Roberts, advertising manager, Canadian Pacific Airlines.

Frank B. Brady has taken a junior partnership in Mills, Petticord & Mills, Washington, D. C., architectural and engineering firm. He was formerly project engineer, Air Transport Assn.

Thomas Hackett, product improvement manager and **Ercole J. Vitali**, assistant chief engineer, Chandler-Evans Division, Pratt & Whitney Co., Inc., W. Hartford, Conn.

Kenneth B. Luskin, administrative assistant to vice president, Delavan Manufacturing Co., W. Des Moines, Ia., supplier of jet engine nozzles to Pratt & Whitney Aircraft Division, United Aircraft Corp.

Norman S. Benedict, aviation safety staff, University of Southern California, Los Angeles, where he will instruct in aircraft accident investigation and prevention.

Allen O. Gamble, project director, National Register of Scientific and Technical Personnel, National Science Foundation. He was formerly with National Advisory Committee for Aeronautics.

Robert H. King, assistant plant manager, Rheem Manufacturing Co., Downey, Calif.

William H. Balentine, plant operations manager, Instrument Division, Thomas A. Edison, Inc., W. Orange, N. J.

Dr. William R. Sears, editor, Journal of the Aeronautical Sciences, Institute of the Aeronautical Sciences, N. Y., formerly director of the graduate school of aeronautical engineering, Cornell University, Ithaca, N. Y.

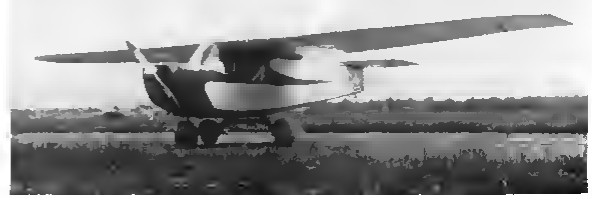
Walter J. Hegedus, sales engineer, Fansteel Metallurgical Corp.'s Metals & Fabrication Division, Cleveland, Ohio.

William J. McGuckin, sales promotion manager, Librascope, Inc., Glendale, Calif.

IN THE AIR the plane has a top speed of about 60 mph., lands at 25-30 mph. Gross weight is approximately 600 lb. It takes Bryan about a half-hour to convert the plane for road travel.

Home-Built Roadable Plane Costs $250

WINGS FOLDED. home made roadable rolls along the highway powered by a pusher mounted 40-hp. Continental. Builder Dewey Bryan plans separate low-power engine for road use.



WINGS EXTENDED. Byran roadable starts takeoff. Costing $250, plane took 3½ years to build. It uses wings salvaged from a glider, tail and engine are from a Corben Baby Ace.

1955 Record-Breaking Year for Airlines

Air traffic boom likely to continue well into 1956 as general economy of nation registers new gains.

By Craig Lewis

Washington—Airline traffic and revenues broke all records in 1955 and brought the airlines a substantial share of the prosperity enjoyed by the U.S. economy last year.

Airline business showed substantial gains in all departments, according to year-end reports of the Air Transport Assn., Civil Aeronautics Administration and other organizations.

Many of last year's gains are tied to the record growth of the national economy. Economists figure that the present boom took on a new momentum in mid-1955 and most feel that it will continue until mid-1956 at least, indicating airline gains will continue well into the new year. The dark spot in the airline picture for the year is the safety record which rose to 0.75 per 100 million passenger-miles from a 1954 low of 0.09 for the domestic scheduled airlines. This figure includes the December crash of an Eastern Air Lines flight at Jacksonville, Fla.

International carriers had a record of 0.04 fatalities per 100 million passenger-miles after a perfect record in 1954 and the irregular carriers had one accident.

Business Flying Up

An ATA tabulation indicates that the scheduled airlines are responsible for a 3% increase in common carrier intercity passenger-miles for 1955. ATA figures are based on actual data for ten months and estimates for November and December.

Railway and motor bus traffic fell off 3% to 8% in the past year while the airlines, with 19.9 billion intercity passenger-miles, had a 19.2 gain, according to ATA. With this increase in airline traffic, total common carrier traffic rose 3% to 60.67 billion passenger-miles in 1955.

Airline intercity traffic in the year was 13.3 billion first class passenger-miles, a 16.9% gain, and 6.6 billion coach passenger-miles, up 24%. In the same period private automobile traffic, considered a key factor in air traffic development, rose 5% to 575 billion intercity passenger-miles.

Business flying increased 10% in 1955 to 4.3 million hours, according to CAA. Airport activity increased 9.2% with CAA control towers handling 19.6 million landings and takeoffs. CAA traffic control facilities received 20.6 million pilots' position reports during the year, a 22.1% gain.

International Gains

The world's scheduled airlines carried 69 million passengers 38.53 billion passenger-miles last year, according to the International Civil Aviation Organization. These figures, which exclude the Union of Soviet Socialist Republics and the Peoples Republic of China, represent an increase of 17% in passengers and 18% in passenger-miles over 1954.

Sir William Hildred, Director General of the International Air Transport Assn., predicted that world airline traffic will increase to 85 million passengers in 1956 and will reach the 100 million mark in 1957, if growth continues to follow present trends.

The Aircoach Transport Assn. reports that traffic of irregular carriers increased about 20% during the year over the 1954 level of 1.24 billion passenger-miles.

Both domestic and international scheduled airline groups showed substantial growth in the past year (see box). The trunk airlines led the way with 19,375 million passenger-miles, a gain of 18.9% over the preceding year. Mail ton-miles were up 8.9%, express traffic up 25% and cargo up 22%. Revenue ton-miles for the trunks increased 20.1% to 2,225 million.

Revenues for trunk airlines were up 16% to $1,133.5 million, including a 16.6 increase in passenger revenues to $1,016.6 million.

U.S. scheduled international airlines flew 4,430 million passenger-miles and 605.3 million revenue ton-miles in 1955, increases of 18.3% and 17.9% respectively.

They also flew 45.4% more U.S. mail ton-miles and 6.3% more foreign mail ton-miles in the year. Cargo traffic for the international air lines was up 10.9%.

Subsidy Drops Sharply

U.S. flag airline revenues showed substantial gains in all categories but foreign mail, which dropped 2.8%, and subsidy, which fell off 73.3% from $28.5 million to $7.6 million. Passenger revenues went up 15.2% to $292.8 million, and total revenue increased 7.7% to $387 million.

Local service airline traffic increased by nearly a third. Revenue passenger-miles went up 28.9% to 525 million and revenue ton-miles increased 29.4% to 53.9 million. Mail traffic increased 18.3%, express 42.3% and cargo 35.1%.

Total revenues for the local airlines don't reflect the dramatic traffic growth since subsidy was cut during the year. Passenger revenues showed a gain of 16.7% totaling $33.1 million, but subsidy income went from $23.7 million to $19.7 million, a 16.7% drop. Total revenues increased only 2% to $56.9 million.

Helicopters Traffic Booms

Revenue ton-mile traffic of the territorial airlines was 8.9 million, a 15.6% gain, and total revenues were $7.5 million, an increase of 13.8%. Alaskan carriers increased traffic 48.4% to 28.8 million revenue ton-miles and revenues 14.8% to $22 million.

Helicopter carriers operated 795,000 revenue passenger-miles, an increase of 334.4%. Revenue ton-miles rose 30.9% to 195,000. Total revenues for the helicopter lines were $3.5 million, including $2.7 million in subsidy, for a revenue gain of 12.3%.

The CAA safety statistics for the year are based on seven fatal accidents. The figures don't include the crash of a United Air Lines flight at Longmont, Colo., which killed 39 passengers and 5 crew members and has been traced to sabotage.

In the seven domestic accidents, 156 passengers lost their lives. The single international airline accident caused two passenger deaths.

The CAA report shows there were 60,500 active U.S. civil aircraft in 1955, a gain of 2.6%. Scheduled air carrier aircraft total 1,490, including 780 two-engine and 690 four-engine types.

During the year, the CAA issued 12,000 commercial pilot airman certificates, a 21.5% increase and 2,500 air transport pilot certificates, a 12.9% gain. Student pilot certificates dropped off from 43,393 to 40,000 last year, and private pilot certificates decreased 2.7% to 16,000. An 8.6% drop in mechanic certificates is reported with a total of 5,000.

Airline Traffic, Revenue Statistics

Here are the traffic and revenue statistics for the scheduled airline industry for 1954 and 1955 with the percentage of gain or loss. Loss is shown in parentheses

REVENUES
(000 Omitted)

Passenger	1,356,435	1,166,554	16.3
Mail	61,739	57,911	6.6
Foreign Mail	9,195	9,461	(2.8)
Express	20,292	15,638	29.8
Freight	74,895	65,784	13.8
Other	49,594	39,276	26.3
Operating Revenues	1,572,150	1,354,624	16.1
Public Service	38,407	66,223	(42.0)
Total Revenues	1,610,557	1,420,847	13.4

TRAFFIC
(000 Omitted)

Revenue Passenger-Miles	24,527,970	20,605,058	19.0
Mail Ton-Miles	141,890	118,293	19.9
Foreign Mail Ton-Miles	7,800	7,338	6.3
Express Ton-Miles	51,680	41,175	25.5
Freight Ton-Miles	283,292	236,623	19.7
Revenue Ton-Miles	2,922,168	2,434,657	20.0

Air France, Panagra and Sabena Order Jets with JT4A-3 Engines

Air France, Pan American Grace Airways and Sabena Belgian World Airlines last week placed their first orders for American jet airliners. Air France and Sabena, respectively, ordered ten and three 290,000-lb. Boeing 707-320 Intercontinentals. Panagra contracted with Douglas for four 275,000-lb. DC-8s.

Sabena announced that its Intercontinentals would be powered by four Pratt & Whitney Aircraft JT4A-3 engines, the commercial version of the J75.

Presumably, Air France's Boeings and Panagra's DC-8s will use the same engine.

Thrust of the JT4A-3 will be between 17,000 and 18,000 lb., according to latest estimates. Airlines have been told by the aircraft manufacturers that the P&WA J57, which will power the Boeing 707 Jetliner and smaller versions of the Boeing 707 and DC-8 will have a takeoff thrust of 13,000 lb., with water injection, and a cruise thrust of 11,500 lb. The J75 or JT4A-3, it is estimated, will provide 50% greater thrust than the J57.

Intercontinental Design

Earlier, Pan American World Airways ordered 12 Boeing Intercontinentals, exercising an option in substituting the bigger aircraft for an unspecified number of the 707s ordered in October.

The Intercontinental will be 50,000 lb. heavier than the 707, have a range in excess of 4,000 mi. with a full payload of 36,500 lb. and full fuel reserves. Payload is up 8,500 lb.; fuel capacity is increased 3,800 gal. to 21,200 gal.

The Intercontinental design is 146 ft. 8 in. long and has a wingspan of 141 ft. 6 in. Wing area is increased 20% or 475 sq. ft. for "utilization of shorter runways for takeoff and landing."

Pan American is scheduled to receive its first Intercontinental in Aug. 1959.

Deliveries to Air France will begin Nov. 15, 1959, with final delivery on its contract set for Nov. 10, 1960.

With the Boeings, Air France says it will fly between New York and Paris in six and one-half hours. For its short-range routes in Europe and the French Union, the French airline has purchased 12 twin-jet Caravelle airliners.

Sabena's Jets

Sabena's jet airliners will carry 126 passengers, 98 in tourist class and 28 in first class. The first-class compartment will be forward and the tourist cabin aft. Each will have its own entrance, service door and galley.

New York to Brussels schedules will be cut to six hours 35 min. from the present 14 hours. Nonstop flight between Brussels and Leopoldville in the Belgian Congo will take seven hours 50 min.

Panagra says its 575-mph. DC-8s will reduce travel time between New York and Buenos Aires with one stop to 11 hr. Present schedules take 22 hr. With a full load, the DC-8s will have a range of 4,950 mi., according to Panagra, providing non-stop flights between New York and Lima, Peru, Miami and Santiago, Chile, and Panama and Buenos Aires.

Deliveries to Panagra are scheduled for early 1960.

Pan American Subsidy Reduced to $9 Million

Washington—Pan American World Airways' annual subsidy has been cut by more than half by a Civil Aeronautics Board action which put PanAm's entire system on a permanent mail rate basis for the first time.

The CAB has proposed new rates, effective Jan. 1, 1955, for PAA's four divisions which cut subsidy from the $22 million estimated for 1954 to $9 million a year starting in 1955. By applying profits from aircraft sales, 1955 subsidy is cut to less than $2 million.

In its opinion, the Board said it believes that the proposed rates will provide a favorable climate in which Pan American can successfully complete the equipment program it has recently started. The fact that the whole airline is on a final rate should benefit its financial status immeasurably, according to the CAB, and the airline management will have added incentive to get off subsidy.

The CAB points out that with recent traffic growth, PanAm's system, like other U.S. carriers, has a new low subsidy requirement. "In view of the fact that this system provides worldwide services in the national interest, that it offers 4,164,037,000 seat-miles in a year, and that it flies over 76,353,000 plane-miles a year, the reduction of the need for government assistance in the past several years has been gratifying," the Board said.

Total mail pay for the PAA system is estimated at $24,120,000, including $1,569,000 for the Alaska Division, $8,179,000 for the Atlantic Division, $8,068,000 for the Latin American Division and $6,304,000 for the Pacific Division. From this total the CAB has subtracted $679,000 as an estimate of annual non-divisional income available to reduce subsidy, leaving a total system annual mail pay of $23,441,000.

With annual service mail pay forecast at about $14 million, annual system subsidy under the proposed rates will be $9,859,000. The 1955 subsidy is reduced to $1,937,000.

In its opinion, the CAB says it may institute a proceeding involving all subsidized carriers to determine whether it is possible to establish a fairly automatic method of reducing subsidy with gains from equipment sales in the future.

Pan American's Alaska Division has been on a final rate since 1951, and the Atlantic Division's final rate was set last year. After review the Board has decided not to change these rates.

The other two divisions are now operating under open rates. The Latin American rate was reopened Dec. 31, 1954, and the Pacific rate Jan. 1, 1954.

CAB Bureau Counsel Recommends N. Y.-Miami Route for Northeast

Washington—A New York-Miami route for Northeast Airlines and expanded East Coast services for National Airlines, Eastern Air Lines, Trans World Airlines and United Air Lines have been recommended by Civil Aeronautics Board counsel, V. Roek Grundman

A public need for a third carrier on the New York-Florida route and a need to help Northeast Airlines in eliminating subsidy are basic findings of Grundman in his brief to the examiner in the New York-Florida Service Case

These are Bureau counsel's recommendations

- **Northeast should be awarded** a route extension south of New York to Miami via Philadelphia, Baltimore, Washington, Jacksonville and Tampa.
- **National's routes should be amended** to extend its service north of New York to Boston via Providence. A restriction against serving Norfolk and Richmond-Washington or Baltimore on the same flight and one requiring flights serving Richmond, Washington and/or Baltimore to originate or terminate at Charleston, S. C., or beyond would be lifted. National's temporary authority to service Newport News-Hampton-Warwick should be made permanent.
- **Eastern's restrictions** on service to Boston-Providence-Hartford and New Haven should be removed, as should a long-haul restriction on traffic between Tampa-St. Petersburg-Clearwater and Miami. Tampa-St. Petersburg-Clearwater should be added as an intermediate point on Eastern's Miami-Boston Route 6.
- **TWA's Washington-Baltimore** segment should be extended to New York and Boston with a long haul restriction requiring flights serving Washington and Baltimore, and New York and/or Boston to originate or terminate at Chicago or beyond.
- **United's Washington-Baltimore** segment should be extended to New York and Boston with flights between Washington or Baltimore and New York required to originate or terminate at Chicago or beyond.

Balance Necessary

Bureau Counsel Grundman narrows his choice of a third carrier on the New York-Florida route to Northeast and Pan American World Airways on the grounds that seasonality and subsidy need are the primary issues in the choice. Both carriers eventually require subsidy.

Since traffic between the Northeast and Florida is highly seasonal, Grundman feels a third carrier in the market should have a balancing seasonal peak. Both Northeast and Pan American have their peak demands in the summer season, leaving their operation slack during the peak winter season in Florida.

Grundman said his choice lies with Northeast because it is necessary to strengthen that carrier and broaden its competitive opportunities in line with the CAB objective of developing a sound route structure. He feels the choice of Northeast for the new route will achieve that result.

Fail to Keep Pace

According to Grundman's brief, Northeast would get access to high density markets expected to produce 3,265,427 passengers and 1,999,402,000 revenue passenger-miles in 1956. He points out that such access would enable Northeast to lengthen its average haul and decrease its unit cost and would increase the flow of traffic over its present system.

In his brief, Grundman says that National and Eastern are not charged with providing inadequate service, but that both carriers have borne a substantial part in developing the Florida market. He says the efforts of the carriers have apparently not kept pace with increasing demand because of its seasonal character.

While certification of another carrier on the route won't solve problems of seasonal imbalance, it will provide capacity to meet peak directional and seasonal demands, Grundman states.

Grundman said that while the entry of a third carrier in the New York-Florida market might slow up the rate of growth of National and Eastern, it "will not seriously affect their present health, financial condition nor jeopardize their ability to render adequate service over the route in question."

Comet Completes Journey

De Havilland's Comet 1H returned to London Airport last Wednesday to complete a 30,000-mi.-round-the-world proving flight designed to restore international confidence in Britain's jet transport.

Piloted by de Havilland chief test pilot John Cunningham, the Comet 1H crossed the Atlantic from Montreal in 6 hr., 18 min. at an average speed of 548 mph. to record the fastest time a passenger plane has ever flown the ocean. At the trip's conclusion Sir Miles Thomas, board chairman of British Overseas Airways Corp., said the flight "vindicated our faith in British jets."

The global flight was marred in Canada by a malfunction in a hot air duct in No. 3 engine. Due to leakage because of an inadequately tightened connection, hot gases seeped into the engine compartment, setting off a fire warning signal. Cunningham brought the plane down without incident, and it was repaired in Toronto.

United Obtains $150 Million-Jet Financing

United Air Lines has completed a $150 million deal, largest single airline financing program ever negotiated with three insurance companies and a banking group to meet the financial needs of its jet equipment program.

The airline has arranged for $120 million in new debentures and a $30 million bank credit.

Eastern Air Lines arranged to borrow $90 million from Equitable Life Assurance Society and American Airlines secured financing of $75 million from Metropolitan Life Insurance Co. last November (AW Nov. 7, 1955, p. 109). Both programs are designed to bear part of the cost of new equipment.

United's arrangements are with the Prudential Insurance Co. of America, the Mutual Life Insurance Co. of New York and Metropolitan Life. They provide for the sale of up to $120 million in new series D, 4% debentures in installments as needed over the next several years. Harriman Ripley and Co. was United's agent in the debenture financing.

The airline's credit agreement is with a 35 bank group headed by the First National City Bank of New York. The credit was effective Dec. 1 and calls for repayment of loans over a five-year term. United hasn't yet drawn on the credit which makes $30 million available up to Dec. 31, 1960.

The sinking fund for the debentures will retire the issue by 1981, according to W. A. Patterson, president of United. He said that accomplishment of the program gives United assurance that "it will be in a strong position to meet the financial needs of the jet age."

The United jet order, which the new financing will help pay for, calls for delivery of 30 DC-8 aircraft and spares starting in May, 1959 at a total cost of $175 million.

Airlines Challenge CAB Decision In Southwest-Northeast Awards

Washington—Decision by the Civil Aeronautics Board in the Southwest-Northeast Case, which creates a new pattern of airline competition (AW Nov. 15, p. 12), has been challenged in varying degrees by the airlines concerned.

A mixed reaction to the Board's decision is particularly noticeable in the petitions for rehearing, reargument and reconsideration filed by two of the three winners of major route awards—Capital Airlines and Delta Air Lines. The absence of any move by Braniff Airways is considered significant. Braniff gets an entirely new route between Dallas/Fort Worth and New York and Washington via Memphis, Nashville and Chattanooga.

Strongest request for CAB to revise its Southwest-Northeast decision was made by Capital Airlines. Winner of an amended route pattern which extends service from Washington to New York, Atlanta to New Orleans via Birmingham and Mobile, and local service between Philadelphia and Pittsburgh, Capital wants the Board to make the following three major changes that would:

- **Deny Delta Air Line's** application entirely.
- **Deny American Airline's** application to serve Houston.
- **Extend Capital's** Route 51 beyond New Orleans to Houston as a new terminal point.

The Capital petition, however, was countered by Delta's objections to the awards made to Capital with the exception of local authority for Pittsburgh-Philadelphia service. Delta told the Board the 3 to-2 decision favoring Capital has the "tendency to weaken the professed strengthening of Delta." Delta sought no change in the Board's grant of new authority to Braniff for a competing Dallas/Fort Worth-New York service.

Positions taken by the Big Four carriers—American, Eastern, Trans World and United—were in sharp disagreement as to the effect the decision would have on each carrier. None of the Big Four, however, otherwise complained of the Board's concessions to strengthen the regional trunk lines.

Here is how the Big Four want CAB to change its decision:

- **American Airlines** thinks its San Antonio restriction should be lifted and more flexibility of service permitted for its proposed Houston operations. The San Antonio-Northeast restriction was not modified, American contends, because CAB fears that American will divert San Antonio—Dallas/Fort Worth traffic from Braniff. American says this restriction inconveniences some 74,000 San Antonio passengers now carried annually and "American is going to carry these passengers whether or not the restriction is modified."
- **Eastern Air Lines** says there are deficiencies and discrimination in the Board's decision that can be remedied only by granting the original application for extensions to Dallas/Fort Worth.

Such authorizations, Eastern said, should include:

Intermediate Pittsburgh service on the Northeast-Atlanta-Texas Route 5 by extension from Birmingham to Dallas/Fort Worth via Jackson and Shreveport.

Further extension from New Orleans to Dallas/Fort Worth.

Extension of the Northeast-Chattanooga "dead end" terminal segment of Route 5 beyond Chattanooga to Nashville, Memphis and Dallas/Fort Worth.

Inclusion of Pittsburgh as an alternate intermediate point on Route 5 between New York and Nashville.

- **Trans World Airlines** claims its award of Tulsa and Oklahoma City is hampered by the long-haul restriction and asks for removal or modification. The transcontinental carrier noted that the traffic flow between the two Oklahoma cities and TWA cities in the Ohio Valley and the northeast is five times greater than the traffic between Oklahoma City/Tulsa and the West Coast. The proposed restriction, TWA says, will seriously curtail any benefits to both Tulsa and Oklahoma City for services to the East.

At the same time, TWA wants CAB to deny Capital Airlines authority for local Pittsburgh-Philadelphia service and American Airlines routes consisting of Columbus-New York, Columbus-Pittsburgh, Dayton-New York and Dayton-Pittsburgh.

- **United Air Lines** wants CAB to stay its awards to both American and TWA. The Board was criticized for not considering United's original applications for new routes between Southern California, Texas, Oklahoma and the East Coast. United said in its petition that the Board's action in denying comparative consideration of its application was contrary to principles established in the Ashbacker Case and a recent Court of Appeals decision involving Delta Air Lines.

United also asked CAB to defer its decision on additional operating authority for other carriers between Washington and New York until United application for similar service is decided in the New York-Florida Case.

- **National Airlines** in a separate plea supported United's objections to new and additional services between Washington and New York. National said the need for local New York-Washington service is a major issue in the New York-Florida Case and the final decision should be made there. In addition, National wants the Board to impose a restriction on Delta's newly-authorized service between New York and Atlanta to prevent through service south of Atlanta and an appropriate limitation on Capital Airlines to prevent through service between New York-Philadelphia and Norfolk-Newport News. An objection was also raised to granting Delta permanent authority between New Orleans and Houston until National is heard on its application for extension of Route 39 from New Orleans to Houston.

CAA Calls Meeting On Jet Airport Needs

A joint industry-government meeting to discuss civil airport needs for commercial jet transports has been called by the Civil Aeronautics Administration.

Charles J. Lowen, Jr., CAA Administrator, will preside at the meeting, which will be held Jan. 11. In inviting industry participation, Lowen said, "With these jet transports now entering the design stage and the manufacturers having a clearer knowledge of the probable performance characteristics of the aircraft, it is important to see what steps may be necessary to assure adequate airport facilities." He added that "through sound planning now, we can be ready for the aviation needs of the 1960's with the minimum expenditure by both Federal and local government."

Major phases of the discussion of airports for jet use will be runways, taxiways, loading areas, ramp servicing, buildings and approach clearance. Other subjects include the effects of blast, heat and spillage on the pavement, concrete or asphalt, whether the jet aircraft will taxi or be towed, what fire protection will be required during fueling, whether airports will require noise buffer zones, and many other questions affecting airports for civil jet transport use.

Industry representation at the CAA jet airport meeting will come from the Air Line Pilots Assn., Air Transport Assn., Aircraft Industries Assn., Airport Operators Council, American Association of Airport Executives, National Air Transport Coordinating Committee, Civil Aeronautics Board, Navy and Air Force also will be represented.

Transpacific Travel Sets Record; Tourist Fares Behind Increase

By Bernie Lang

Los Angeles—Summer passenger traffic across the Pacific this year surpassed all expectations, with tourist-class flights registering the largest gains.

In exceeding the already optimistic predictions, July and August passenger travel registered an increase of more than one third over the peak months of 1954 and accounted for the biggest season the three transpacific U. S. scheduled airlines have had to date.

Without exception, tourist class travel represented the major portion of this record travel, which included these gains:

- Pan American World Airways recorded gains over last year of up to 35% during the summer rush, 10% above the anticipated traffic increase.
- United Air Lines gained 32% over a year ago, 12% beyond predictions.
- Northwest Orient Airlines predictions were borne out in a 37% gain.

Preparations by the airlines for still greater increases next summer already are underway. Herbert F. Milley, traffic and sales manager of Pan American's Pacific-Alaska Division, says:

"We are planning on the biggest tourist summer in the history of transportation in the Pacific, not only to Hawaii but all over."

The past season's high volume boom can be attributed generally to these factors:

- More conversions to tourist service.
- Stepped-up promotion programs.
- Pay-later plans.
- Newer equipment.

All of these factors are expected to contribute greatly to 1956 increases.

Pan American

A total of 17,237 revenue passengers were flown on Pan American's Pacific routes during July, an increase of 20% over the 14,381 flown in the same month of 1954. In August, the total was 18,819, 22% more than the 15,383 for August, 1954.

Pan American's greatest increase was on routes to and from the Orient, with increase in both business and tourist travel to and from Tokyo, Hong Kong and Manila. Passenger traffic to the Orient, as compared with the same months of 1954, rose 34% in July and 25% in August.

From the Orient to the U. S., it jumped 39% in July and 50% in August. South Pacific and Honolulu traffic also showed substantial gains.

During the summer, Pan American's route between Hawaii and the Pacific Northwest cities of Seattle and Portland came more into the picture. A spokesman for the airline reported:

More persons were traveling back and forth between the two areas. Travelers from Honolulu and the Orient bound for elsewhere in the U. S. were choosing this gateway as an alternate route."

At the moment, Pan American has no new equipment scheduled for operation during the peak months of next year. It has on order, however, a fleet of 33 DC-7s, some of which undoubtedly will be assigned to Pacific routes," the airline's spokesman said.

United's Gains

United Air Lines, which flies to Hawaii and not beyond, handled a total of 10,681 passengers during the summer traffic peak, an increase of 32% over 1954.

Traffic between San Francisco-Honolulu (in both directions) was 27.6% higher in July and August than in the same months of 1954. The Los Angeles-Honolulu route showed a 30.6% increase in July and a 43% gain in August over the July and August periods of 1954.

United will be flying DC-6Bs over its Honolulu coach service in 1956 with a seating capacity of 75 per airplane, according to S. R. Newman, United's western regional sales manager. "This will," he said, "give us a 30% increase in seating capacity in coach configurations and should parallel the demand."

Northwest Orient

Expanded service over Northwest Orient Airlines' Great Circle Route was the major factor in its 37% passenger gain over the summer of 1954.

James W. Mariner, Northwest's vice president of sales, said this expanded service included:

Increased number of schedule choices. With the introduction of two class service of Super-G Constellations, NWA now offers 10 separate services across the Pacific each week. An additional weekly round trip will begin on July 1. Another factor was the introduction of new type aircraft.

An added factor during the early summer, Northwest says, was movement of armed forces personnel and dependents by commercial airlines from Japan, because of the shortage of space in military transport ships.

More Promotion

Concurrent with the introduction of new Super Constellations, Northwest stepped-up all types of promotion of its series. "We should be able to project such increases further into the new year."

Orders for DC-6Bs and DC-7Cs, amounting to $42 million, are scheduled for delivery within the next two years. Donald W. Nyrop, Northwest's president, recently announced that the airline will decide, probably within the first six months of 1956, to buy between eight and 10 jet transports from either Boeing or Douglas.

Although the DC-7Cs will not go into service until 1957, Northwest says it has effectively increased its carrying capacity by reopening Shemya airstrip at the tip of the Aleutian Island chain as a refueling base for flights to and from Japan. Flying distance is 900 miles shorter than the previous Cold Bay, Alaska-Tokyo route, Mariner said, allowing an increase in payload of about 40% and an increase in number of seats of about 11%.

Reopening of Shemya under a 10-year lease with the Civil Aeronautics Administration makes Northwest the first American carrier ever to operate its own airport. Also, it is the first commercial purchaser of a Gilfillan GCA unit to facilitate all-weather operations.

Present schedules have Northwest flying one-stop between Japan and the U. S. (Tokyo-Shemya-Seattle-Tacoma) four times a week. The scheduled additional flight will go via Anchorage. All westbound flights, because of prevailing headwinds, stop at both Anchorage and Shemya.

Pacific Traffic Increases

	Tourist July-August			First Class July-August		
	'54	'55	Gain	'54	'55	Gain
U. S.-Honolulu	6,298	7,944	26%	20,559	26,558	28%
U. S.-So. Pacific	893	914	2%	464	616	32%
U. S.-Orient	3,519	4,356	23%	3,545	5,328	50%

This table includes U. S. carriers only. Japan Airlines says its peak season is August-October, and reports a gain of 53%. During these three months of 1955, it carried 3,300 passengers between Tokyo and Honolulu and U. S., compared with 2,153 in 1954.

Inadequate Aids Bog Transocean Traffic

By R. C. Robson*

New York—Inadequate air navigation and communication facilities are seriously hampering North Atlantic air traffic and the situation is steadily worsening.

North Atlantic crossings run as high as 3,000 a month. There are at any time during the day about 75 aircraft en route between Gander, Newfoundland, and Shannon, Ireland. Commercial airlines carried 250,000 passengers between Europe and the U. S. in 1948. They will carry 750,000 passengers in 1955. Predictions are that by 1960 there will be 2 million passengers flying the Atlantic.

There are three major factors causing congestion across the 2,000-mile northern route:

- Communications.
- Navigation facilities.
- Aircraft performance.

Communications

There is a complete absence of direct communication. Communications at airports are put on the local teletype circuit and routed to the station communications center where they are retyped for retransmission across the Atlantic by radio teletype.

Centers Clogged

The communications center is one of the big bottlenecks in the process. All messages pass through this point. Aircraft position reports are sent to the center for redistribution. These reports contain 18 elements of information, including a complete weather summary as well as the aircraft's position in latitude and longitude. In addition to these reports and traffic clearances, airline company messages use the same circuits which increase the message load.

Clearance messages and position reports are only two of the several forms of information on each flight that clear through the communications center. There also is a departure message when the plane is airborne. It is the responsibility for the originating airport to monitor each flight and there must be a message to the originating point when the aircraft arrives at its destination. The arrival messages, which have a low priority, are sometimes hours late. There are cases where the message has been received the day after the arrival of the aircraft.

It is not unusual for a routine clearance request to take an hour before it is delivered. This time is consumed by the mechanics of transmitting the message to and from the airplane, the communications center and the traffic controller.

Only the original sender has the authority to cancel a message. In many cases a flight will reach its destination before receiving an answer to an inflight request. Although it is obvious that the information is useless after the flight is terminated, the message still continues through the process.

False Alerts

Even if the radio teletype circuits were able to operate a full speed around the clock the problem would still be great. There are numerous breaks in transmission in the far north, due to radio propagation difficulties, some lasting as long as 10 hours. When the circuits go dead, operators are forced to use the Morse hand key which is a time-consuming method.

Propagation difficulties many times makes it impossible for an aircraft to make routine reports. If an aircraft is unreported, the center issues an alert for the "missing" aircraft. The Gander center in 1953 issued more than 400 emergency alerts. In 85% of the alerts, the cause was found to be inability of the aircraft to make contact.

Each alert consumes 30 minutes of the controller's time. Routine messages are further delayed.

Iceland and the Azores, two important stations, lack radio teletype facilities and use only hand Morse. They are also used as relay points for messages. Lisbon, for example, reports through the Azores station.

Hand Morse also is subject to propagation problems and at times it is necessary to use commercial cables. This is expensive. The only direct center to center land line is between the New York Ocean Center and Gander, Newfoundland, and one link across the Gulf of St. Lawrence is by radio.

Inevitable Transmission

Another complication to the traffic control system is the devious channels used by North Atlantic operators. Military planes usually make direct contact with the headquarters through military radio frequencies. These transmissions by-pass the center completely and must be relayed back.

In some cases an aircraft is unable to contact a land station, but is able to contact a U. S. Navy or Coast Guard vessel. The Navy vessel relays messages to Washington and then they are retransmitted to the proper destination across the Atlantic. The waste of time and airspace is enormous.

A typical situation is the assignment of an aircraft reporting its position to South America to an altitude of 17,000 ft.

Although the aircraft has usually vacated a given sector, the center cannot use this airspace since it hasn't received a report from the aircraft. This causes large areas of vacant airspace to go unused while the message is in the process of transmission.

Centers have worked out a system to combat this situation by making local arrangements for the assignment of certain blocks of altitude to each other for definite periods. Gander may take 12-13-14 15,000 ft. while Shannon takes 16-17-18 19,000 ft. This permits more positive control and speeds clearances. Main objection to this plan is that each center may not need exactly four levels.

Space Assignments

To cope with the uncertainties of position reports and provide adequate safety it is necessary to assign each flight large blocks of airspace. Separation is provided by alloting 120 miles for lateral spacing, a minimum of 1,000 ft. vertical spacing and up to 30 minutes longitudinally.

Each center keeps track of individual flights by marking off zones of 5 deg. of longitude and using these lines for posting aircraft fixes.

Difficulty with this system is the fact that aircraft do not necessarily give their position or its next estimated position on these 5 deg. lines. An aircraft may estimate its next position at 32 deg. west longitude. The controller then must interpolate to post the fix at 30 deg. This occurs on numerous flights and the center spends considerable time working flight plans and interpolating positions.

Navigation Aids

There is no "common system" long range navigation aid used by all North Atlantic operators. Some use celestial navigation, others Loran or Consol and other systems. Result is that no precise tracks or intersections can exist.

The navigation aid problem is twofold:

- Long-range aid requirement.
- Terminal area aid requirement.

A major requirement is a long range aid that will provide an adequate number of precise over ocean tracks accurate enough to reduce the present 120 mile lateral spacing. This system also must provide for a sufficient number of ac-

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curate fixes along these tracks so that forward progress can be determined without interpolation which reduces the required longitudinal spacing

Even greater precision is required for the navigation aids at terminal areas as well as a greater number of fixes. The exact terminals have good equipment, but the need is within the 150-mile area. The fixes are needed to serve as holding points, as "gateways" to over-ocean tracks, climbing patterns and to facilitate access to various altitude levels

At the present time there is no framework of defined tracks and fixes upon which a traffic control system could be built. Until this framework is established through a standard system of long range navigation, it is necessary to continue the practice of assigning large blocks of airspace to each flight.

Aircraft Performance

Aircraft operating on the transatlantic routes have their own special requirements for long range flight. Not one can cope with a standard, or pre-planned, traffic system across the ocean. Each flight is a separate case and air traffic control must fit itself to the aircraft concerned.

Fuel is the principal problem. Each plane has an altitude at which it must operate in order to obtain the best performance.

There are three general classes of aircraft operating in transocean traffic:

- Unpressurized planes which operate at altitudes below 10,000 ft.
- Pressurized aircraft which operate above 10,000 ft, usually between 14,000 and 21,000 ft.
- Jet aircraft which normally cruise above 30,000 ft.

Traffic tends to congregate in these three regions according to class. There are within these three regions one or two altitude levels which are most favorable from the wind and weather standpoint. The most favorable conditions for one type is usually the most favorable for all in a particular class. The result is that each class seeks almost the same altitude. The only way for a maximum number to operate in the favorable altitudes is to provide closer spacing so that each level carries more traffic.

The same situation applies to routes. There is usually one single route desired by many flights. The net result is that the seemingly vast area available over the North Atlantic is a myth. Most of the traffic is squeezed into a small segment of the total available airspace.

There are several different methods of flying the ocean:

- Great Circle.
- Pressure pattern.
- Rhumb line.
- Minimal flight path.
- Lindy line.

In addition, there are various private techniques. The task of fitting these different flight paths on one map without having its lines cross is extremely difficult.

Climbing Problem

The step climb is another technique, a combination of best route and altitude. A departing aircraft heavily loaded with fuel will not use high power merely to transport this fuel to a higher altitude because of the high rate of fuel consumption during the climb. The flight stays low and as the fuel load lightens the aircraft climbs in a series of steps until the desired cruising altitude is reached.

This is a good method except that an aircraft often is two or three hours out over the ocean and then finds it impossible to climb because the higher altitudes are already blocked with traffic. It is impossible to reach the destination flying at a low level so the flight returns to the originating point to refuel or lands en route for fuel. For example, a Shannon to New York non-stop flight may be unable to climb and is forced to land at Gander for additional fuel. It sometimes happens that the aircraft is overweight for an unplanned landing and must pump fuel before it can land to obtain more fuel.

Flights can waste from two to seven hours because of these difficulties and the profit of the trip soon disappears.

Another complicating factor is the time of day. Most airlines schedule flights at the same hour for competitive reasons. This causes 60% of all transatlantic traffic to land at Gander in less than half a day.

The combination of stringent aircraft requirements, lack of navigation aids and communications makes it noteworthy that the ocean centers are able to move as much traffic as they do. The prediction for increased ocean air travel makes it mandatory to improve the present traffic control system.

Testing New Systems

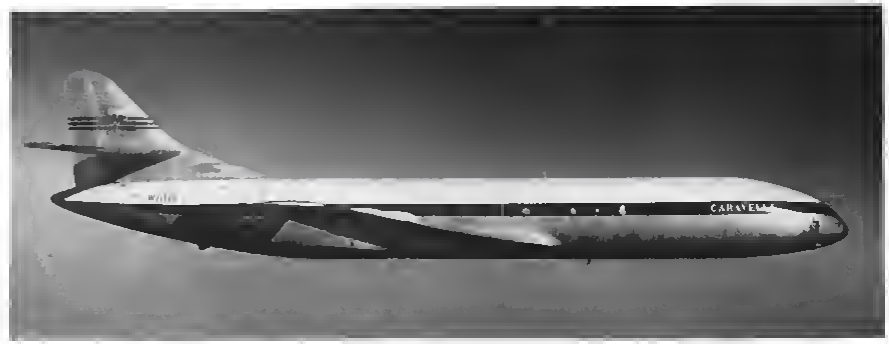
There are several devices and systems being tested in an effort to solve some of the traffic control difficulties. Promising results have been obtained in experiments with ground wave propagation of radio signals. By placing transmitters near water and taking advantage of the superior electrical conductivity of the ocean there has been a considerable improvement in reception.

There is also a program for converting the hand Morse system to radio teletype as well as plans to install transatlantic interphones between controllers.

At the present time there are not enough frequencies and too many aircraft are on one party line. Some of the airlines have radio operators who can send Morse messages, but both the International Civil Aviation Organization and International Air Transport Assn require all messages to be sent by radio telephone despite the lack of facilities.

'Quiet' Sign at Newark

Newark Airport, in an effort to reduce noise and placate near-by residents, recently installed the above runway sign reminding pilots of special takeoff procedures designed to eliminate takeoff noise over populated Elizabethport. The procedures are used whenever wind and weather permits the turns to be made with safety.



S. E. 210 Caravelle

Latest aerial photograph of the Snease S E 210 Caravelle points up the clean lines of France's medium-range jet transport. Cruising speed of the twin-jet airliner is 435 mph. Dive runs have been made at Mach .86 during Snease test flights.

Frontier Asks Board Survey To Help Lower Subsidy Needs

Washington—Frontier Airlines has asked the Civil Aeronautics Board to open a general investigation of its operation to find a means of reducing the carrier's subsidy.

The local airline wants CAB to hold off on trunk airline applications for routes in its area until the investigation is complete.

Frontier says that piecemeal consideration of its problems in trunkline route proceedings is inadequate and must "Consideration of trunk applications running through Frontier's area will completely change the issues so that Frontier's problem will almost entirely be lost sight of," the carrier said in its petition.

Pointing out that trunk proceedings are long and expensive, Frontier says it has adequate capital to carry on normal business but hasn't the resources to prosecute a series of route cases. 'Frontier gets lost in the battle between the giants," the petition claimed.

Decisions Cited

The carrier cites the September subsidy survey as an indication that CAB doesn't expect Frontier's subsidy to be reduced in the near future. In this survey, the Board estimated Frontier's subsidy for the fiscal years 1955, 1956 and 1957 at about $2.5 million.

"The Congress of the United States will not indefinitely subsidize any carrier," said the petition. "Unless Frontier gets off subsidy, the many intermediate communities on Frontier's system will eventually lose air service, which service is a virtual necessity to them."

Frontier points to recent decisions in the New York-Chicago case, the Denver service case and the Southwest-Northeast service case as indicators that CAB has recognized the need for strengthening of smaller carriers. The carrier observes that the route awards in these cases were made to subsidy-free trunk airlines, with the exception of Continental Air Lines.

Frontier holds that the Civil Aeronautics Act applies equally to local service carriers and trunk carriers, and that CAB should use the same rules to help local airlines get off subsidy that were applied to the trunks.

Seek Improvements

The carrier suggests the Board cover several questions in its investigation, including the issues of whether restrictions should be relaxed and whether trunk carriers should be suspended at certain Frontier points. Frontier also wants the Board to decide whether its route structure should be adjusted or expanded.

In the proposed investigation, Frontier would like CAB to determine what showing should be made by a trunk carrier trying to extend its operations in the local airline's territory. The carrier lists applications of Continental Air Lines, Eastern Air Lines, Trans World Airlines, American Airlines, Western Air Lines, Braniff Airways, Resort Airlines and Northwest Airlines which blanket its area of operation and could cripple Frontier's opportunity for normal development.

Frontier also wants CAB to look into other means of improving its system, such as operating authority "which will economically permit the use of more efficient aircraft."

Frontier's route system present special problems not faced by other local service carriers. Frontier claims the lowest population per stop and the highest ratio of passengers boarded per 1,000 population.

While the system passenger load factor was 46.19% for the first nine months of 1955, the carrier estimates it would need a load factor of more than 95% to break even under present operating conditions.

Special Problems

Frontier operates over a seven state system that stretches from the Mexican to the Canadian borders and includes Montana, North Dakota, Wyoming, Utah, Colorado, Arizona and New Mexico.

Most of the terrain in the area is rugged and makes surface transportation difficult. This means that in a number of instances Frontier offers the only transportation available between the points it serves.

While the character of the area served contributes to a substantial traffic in cargo and mail, it also means a light distribution of population and few large traffic markets to support weak segments.

Terrain presents special operating problems for Frontier's fleet of 12 DC-3s. Sharp altitude and temperature differentials mean weight and payload penalties. On some flights, Frontier flies from such low altitude points as Phoenix and Tucson to high altitude point in Colorado.

A few of the mountainous airports served are above 7,500 ft., and some flights must be operated as high as 13,000 ft. to clear mountains.

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Nonsked Buys 1049-Hs

United States Overseas Airlines has ordered two Lockheed 1049-H Super Constellation convertible passenger-freight transports at a cost of $4 million. Initial delivery is scheduled for May 1957, although one of the planes may be delivered at an earlier date, a company official stated.

Civil Aeronautics Board's recent move liberalizing nonsked services (AW Nov. 21, p. 12) was an important factor in the airlines' decision to buy 1049-Hs, he indicated. U. S. Overseas Airlines currently operates nine DC-4s from Cape May (N. J.) County Airport. He said that it expects to keep the DC-4s after it gets the new 1049-Hs.

CAB Orders

GRANTED

State of Ohio leave to intervene in the North Central-Lake Central acquisition case.

Riddle Airlines an exemption to carry surface mail from New York to Jacksonville until Jan. 1, 1956.

Cinta Limitada, Chilean airline, a foreign air carrier permit to operate between Chilean points and Miami via Lima, Panama City and Havana.

APPROVED

Agreement between various carriers adopted by the International Air Transport Assn. relating to North Atlantic specific commodity rates.

Resolutions between various carriers adopted by the International Air Transport Assn. relating to rate and traffic matters.

ORDERED

Suspension and investigation of a reduced air fare between El Paso and Tampa filed by Peninsular Air Transport.

Lake Central Airlines to show cause why its mail rate for the period beginning May 2, 1955 should not be set at a rate of 67.6 cents a revenue-mile.

Suspension and investigation of reduced fares between Dallas and Oakland and between Miami and Newark, New York, Philadelphia and Washington filed by Aero Finance Corp.

DISMISSED

Flying Tiger Line's application for an exemption to perform a roundtrip charter flight between New York and Moscow, since the FTL application doesn't conform to the spirit or requirements of the Transatlantic Charter Policy.

Reopened service to Fayetteville case, since the airport matter in question has been decided through the issuance of Central Airlines' permanent certificate.

DENIED

Allegheny Airlines' application to suspend service at Baltimore, Md. between Nov. 1, 1955 and Apr. 1, 1956.

Acme Air Cargo Inc.'s motion to expand the international air freight forwarder investigation to include the possibility of a grant of certificates of public convenience and necessity. Petitions for leave to intervene in the case are granted for American Airlines, Eastern Air Lines, Delta Air Lines, Pacific Northern Airlines, Pan American World Airways, Riddle Airlines, Seaboard and Western Airlines, Trans World Airlines, Aerovias Sud Americana, the Aircoach Transport Assn. and the Air Freight Forwarders Assn.

Lake Central Airlines' petition for reconsideration of a Board decision denying Lake Central an exemption to operate between Cincinnati and Zanesville, Ohio.

Shortlines

▶ **British European Airways** had a net profit of $6,888,000 in the period Apr. 1 to Sept. 30, 1955. In the six month period, BEA flew 455,000,000 passenger miles, 25% more than the same period of 1954. Load factors were 72.3% in international operations and 78.8% in domestic service, compared with 70.2% and 74.8% for the 1954 period.

▶ **El Al Israel Airlines** has purchased two additional Constellations, one of which is to replace the plane shot down by the Bulgarians this year.

▶ **Flying Tiger Line** flew 5,828,868 ton-miles of air freight in November, and 53,826,303 ton miles of freight in the first 11 months of 1955.

▶ **Lufthansa German Airlines** has opened a ticket office in Detroit. Other offices are operating in New York, Chicago and San Francisco.

▶ **North Central Airlines** had a net profit of $1,321 in November, bringing the net for the first 11 months to $119,704 after taxes. Net profit for the 1954 period was $33,598.

▶ **Sabena Belgian World Airlines** plans a $250,000 expansion program which will give the airline sales representation in 26 cities in Canada, the United States and Mexico. The expansion will include facilities in Toronto, Mexico City, Denver, Boston, Pittsburgh, St. Louis, Kansas City, Hartford, Houston, Memphis, Tulsa, Minneapolis and Havana, Cuba.

▶ **Seaboard and Western Airlines** flew 1,812,848 ton-miles of commercial freight in November, an increase of 68% over November, 1954.

▶ **Trans-Canada Air Lines** reports passenger traffic grew 13% in 1955 while capacity was increased 16%. TCA flew 814 million passenger-miles in domestic service and 153 million passenger-miles in international operations last year.

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The Advertisements in this section include all employment opportunities—executive, management, technical, selling, office, skilled, general, etc.

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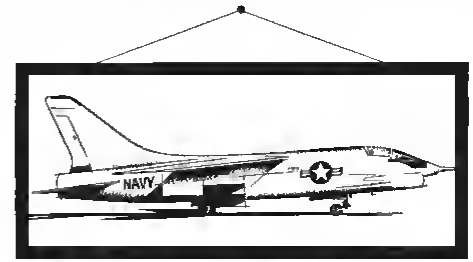

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Executive Transport Aircraft. For complete market report of available multi engine aircraft including Beech, Convair, Curtiss, Douglas, Grumman and Lockheed manufacture write or call William C. Wold Associates, 516 Fifth Avenue, New York 36, N. Y. Telephone Murray Hill 7-2050.

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A DIVISION OF GENERAL DYNAMICS CORPORATION
POMONA, CALIFORNIA

LETTERS

Aviation Week welcomes the opinion of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42 St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Approach Visibility

AVIATION WEEK's continued interest in the application of "end of the runway" rotating beam ceilometer and transmissometer equipment is heartening. On May 14, 1955, AW announced a new system that charts an accurate picture of visibility at the approach, regardless of tower location. Just recently, in the December 5, 1955 issue, AVIATION WEEK published CAB's report of the Braniff Airways accident that occurred last July. A Convair 340, while coming into Chicago Midway Airport, struck an advertising sign, crashed and burned, causing twenty deaths.

CAB's report concluded: "Probable cause of this accident was momentary disorientation caused by the loss of visual reference during the final visual phase of the approach resulting in an increased rate of descent at an altitude too low to effect recovery."

Earlier in the report, CAB states: "Without doubt the accident area was engulfed in dense fog which would limit flight visibility to near zero. It is believed that this was confined to a relatively small area and was unknown to the pilots or to ground personnel in a position to alert them."

"The U. S. Weather Bureau has obtained twenty sets of end-of-the-runway instruments consisting of a rotating beam ceilometer for ceiling measurements and a transmissometer for visibility measurement. Installation of these instruments is being accomplished on a priority basis with high volume traffic airports receiving first consideration. As a result, a ceilometer has already been installed and is in operation at the Chicago Midway Airport; the transmissometer has also been installed but was not yet in operation as of October 31, 1955."

"The program for the installation of the balance of these instruments at various airports will continue during this fiscal year, with 45 additional sets programmed for the fiscal year 1957 as received from the manufacturer. The Board wishes to endorse this program and recommends that it progress as expeditiously as possible."

Developed by the Bureau of Standards and first manufactured by Crouse-Hinds Company, the transmissometer consists of a projector, receiver and indicator recorder. Installed along the runway, the projector sends a concentrated light beam along a 500 foot span to the receiver. The light beam is picked up by a lens system in the receiver and funneled into a photoelectric element located in the receiver chassis. The beam activates an electronic signal that is amplified and transmitted from the element to the indicator-recorder in the control tower where actual runway visibility is charted continuously.

Even though visibility conditions at one end of the runway differ considerably from conditions at the control tower, the tower operator always has precise readings to relay to a pilot approaching for a landing. Moreover, the tower can be located as far as ten miles away from main runways and still receive sensitive readings from the system.

Designed to work in conjunction with the transmissometer, the rotating beam ceilometer—also located in the approach zone—automatically reads cloud height every six seconds, thereby providing accurate readings of ceiling in the approach area.

Again, congratulations on keeping before your readers the importance of this safety equipment.

J. S. HANEY
Manager, Illumination
Crouse-Hinds Company

'No Go' Refunds?

Each week I enjoy your publication—keeping up with the business. I have just completed a carefully planned trip around the country visiting aircraft manufacturers. It is a credit to our airlines that I was able to keep my appointments, even though much of my time was spent waiting around airports instead of sleeping in hotel rooms—which I had reserved, "payment guaranteed."

From time to time I read reports about the airlines concerned over the "no show," and I'm sympathetic. BUT are the airlines giving any thought to the "no go" problem? Can they promise any action? "Mechanicals") etc. cost many passenger hours. When can we depend on our schedules? Rail travel looks especially attractive to me right now.

M. V. BURGGRAAF
2201 Vestal Road
Vestal, New York

Airport Advertising

Thanks to the endeavor of Federal, state and local governments we are fortunate to have numerous excellent new airports and air terminal facilities. Amongst them are the Philadelphia International Airport and the Worcester, Mass. airport which I used recently. Both are beautiful in every detail and excessively lavish in some respects.

What puzzles me however is the presence of a new Chrysler product automobile displayed in the lobby. I ask: Is it in the best interest of aviation to use airports and buildings financed with tax money for such commercial purposes? I question the propriety of using public property to further private interests.

HERB SINGER
320 Cattell Avenue
Collingswood 6, N. J.

AVIATION CALENDAR

Jan. 9-10—Second National Symposium on Reliability and Quality Control in Electronics, sponsored by Institute of Radio Engineers, Hotel Statler, Washington.

Jan. 9-13—Society of Automotive Engineers, annual meeting, Sheraton-Cadillac and Statler Hotels, Detroit.

Jan. 10-11—Yankee Instrument Fair & Symposium sponsored by Instrument Society of America-Boston Sec., Sherry Biltmore Hotel, Boston, Mass.

Jan. 12—Conference on Airport Financing Problems in California, sponsored by Institute of Transportation and Traffic Engineering & University Extension, International House, University of California, Berkeley, Calif.

Jan. 19-21—National Simulation Conference sponsored by Dallas-Fort Worth Chapter of Institute of Radio Engineers' Group on Electronic Computers, Dallas, Tex.

Jan. 23-25—Helicopter Association of America, Inc., annual convention, Sheraton-Palace Hotel, San Francisco, Calif.

Jan. 23-26—Institute of the Aeronautical Sciences 24th annual meeting, Sheraton-Astor Hotel, New York, N. Y. Jan. 23—Honors Night Dinner.

Jan. 23-26—Plant Maintenance & Engineering Show and Conference, Convention Hall, Philadelphia.

Jan. 30-31—Industrial Economics Conference, Statler Hotel, Los Angeles.

Jan. 30-Feb. 3—American Institute of Electrical Engineers winter general meeting, Hotel Statler, New York, N. Y.

Feb. 2-3—National Symposium on Microwave Techniques sponsored by Institute of Radio Engineers' Antenna & Propagation Group and Theory & Techniques Group, Philadelphia.

Feb. 7-9—Society of the Plastics Industry, 11th annual Reinforced Plastics Div., conference, Chalfonte-Haddon Hall, Atlantic City, N. J.

Mar. 19-21—Society of Automotive Engineers, national production meeting and Iotum, Hotel Statler, Cleveland, Ohio.

Mar. 19-22—Institute of Radio Engineers, national convention, Waldorf-Astoria Hotel & Kingsbridge Armory, New York, N. Y.

Apr. 9-12—Society of Automotive Engineers, national aeronautic meeting, aeronautic production forum and aircraft engineering display, Hotel Statler, New York, N. Y.

Apr. 10-11—Symposium for Management on Applications of Analog Computers, sponsored by Midwest Research Institute, University of Kansas City, Kansas City, Mo.

Apr. 18-19—First Annual National Industrial Research Conference, sponsored by Armour Research Foundation of Illinois Institute of Technology, Hotel Sherman, Chicago.

Apr. 22-26—American Association of Airport Executives 29th annual convention, Hotel Carter, Cleveland, Ohio.

May 6-9—Second Annual Symposium on Flight Test Instrumentation, sponsored by Instrument Society of America, Bell Aircraft Corp., Convair and Temco Aircraft Corp., Fort Worth, Tex.

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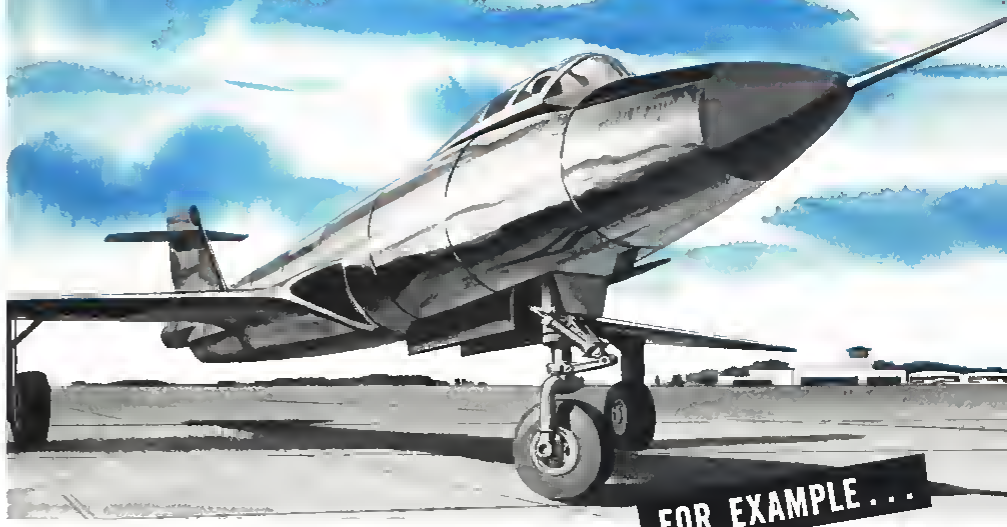

FOR EXAMPLE . . .

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Thus, with one unit performing dual functions, Bendix Torque Link Steering gives important savings in weight, space and maintenance.

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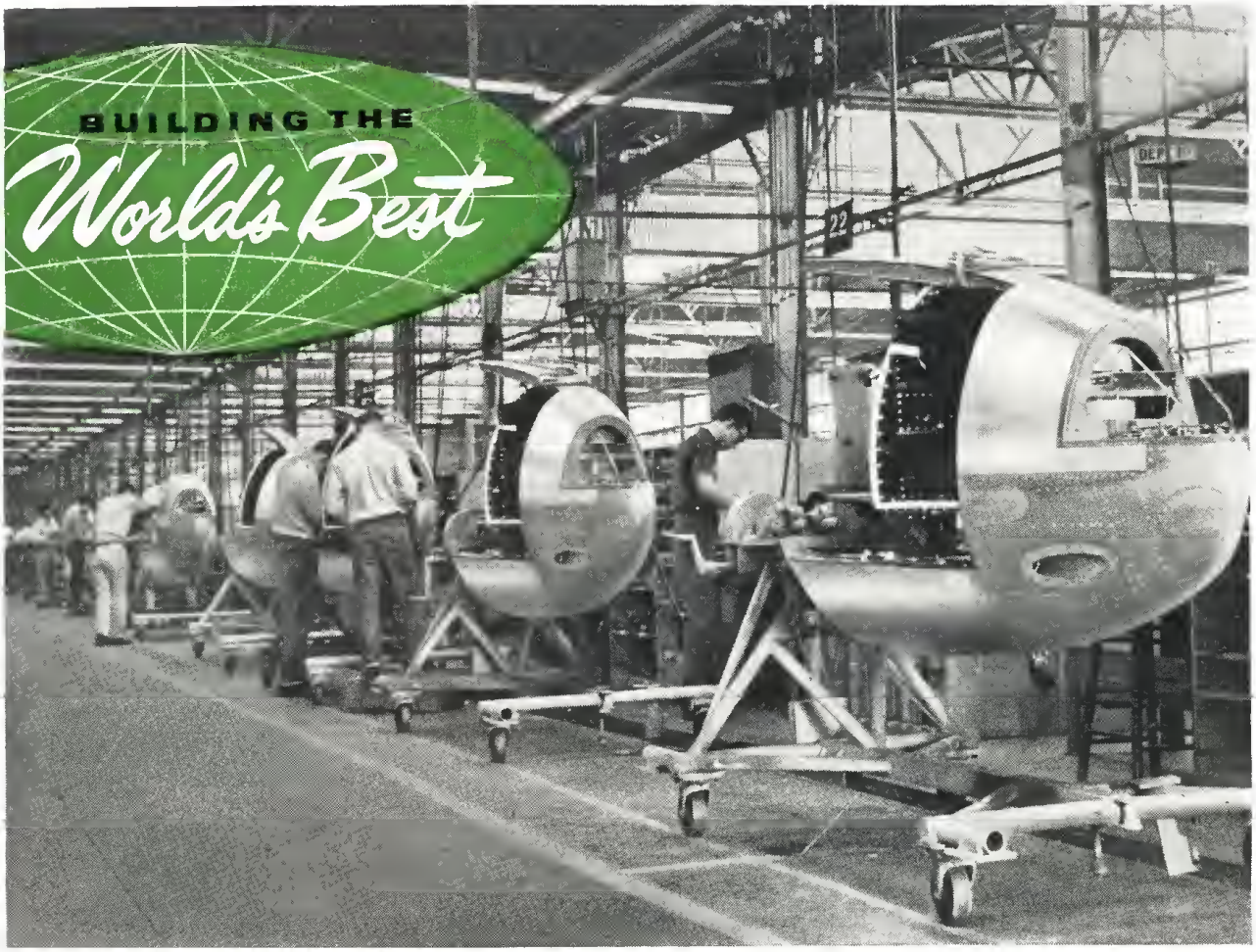
Bendix Products Division

Bendix AVIATION CORPORATION



Lockheed T-33A Trainer Nose Sections on final assembly line at Rheem's Downey, California plant

Jet pilot "School Rooms"— on a RHEEM assembly line

Nose, wing and tail sections, jet engine components and afterburner assemblies, and many key parts of our country's guided missiles are produced by the Government Products Division of Rheem Manufacturing Company at their Downey, California plant.

The nose sections for the Lockheed T-33A two-place jet trainer above—complete with plumbing and electrical wiring ready for installation—are an example of Rheem work as a major subcontractor to the aircraft industry and military services. Strong, lightweight aluminum mill products from Reynolds are called on continuously in Rheem fabricating operations.

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